Audio

MARCH 1987 • $2.25

INTERVIEW/PART II
ISLAND'S BLACKWELL

SPECIAL
COLLECTOR'S ISSUE
STEREOPHONE ILLUSIONS DISC INCLUDED

MAGNAVOX 650 CD PLAYER
TRULY STATE OF THE ART

REVIEWED:
JVC RX-9V RECEIVER
REMARKABLY GOOD DESIGN

THORENS TD 320 TURNTABLE
LOTS OF ENJOYMENT

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06030

BostonAcoustics

The new Boston T1000.

A higher level of sonic architecture.

Announcing the Boston Acoustics T1000 tower speaker system. It elevates stereo music reproduction to a new, rarified level of realism. Yet its slender tower architecture requires very little floor space.

We engineered the T1000 in a distinctive new way. Our new midrange driver is large, letting it reproduce far more of the important mid-frequency information than a smaller driver can. In addition, we placed it – and our CFT-5 dome tweeter – in the highest portion of the tower. As a result, all the directionally important mid and high frequencies emanate together at ear level. Just as with live music.

This unique architecture also frees the dual woofers to concentrate on bass reproduction alone. In fact, the Boston T1000 tower system lets you enjoy the entire tonal range of music, including the very lowest octave. With a wide dynamic range that does full justice to digital sources. And with stereo imaging that's pinpoint precise.

For a descriptive T1000 brochure, just send us your name and address. Boston Acoustics, Inc., Department AT, 247 Lynnfield Street, Peabody, MA 01960. (617) 532-2111.

Silent Running.

CARVER'S FAMOUS TUNING TECHNOLOGY TAKES TO THE ROAD WITH THE ONLY AM/FM TUNER CASSETTE DECKS CAPABLE OF CUTTING MULTIPATH INTERFERENCE UP TO 92.9%!

The new TX-Seven and TX-Nine audiophile autosound decks employ the same Asymmetrical Charge-Coupled FM Stereo Detector circuitry as Carver's revolutionary TX-11a home tuner. They also incorporate an ingenious automatic computer logic-controlled antenna switching system that further vanquishes multipath distortion.

In point of fact, no other autosound decks in the world – regardless of price – even begin to approach the TX-Seven and TX-Nine's ability to maintain a hiss-free, glitch-free FM listening environment in your car.

COMPUTER LOGIC-CONTROLLED DIVERSITY ANTENNA SWITCHING DRIVES AROUND MULTIPATH. One way to get temporary relief from interference at home is to move the antenna around slightly. Instead of physically moving your car antenna, the TX-Seven and TX-Nine use computerized circuitry to switch between *two separate antennas*, one out-of-phase and one in-phase with incoming FM signals.

When multipath occurs, a special "smart" circuit automatically switches (at the speed of light) to the other antenna, automatically correcting phase and eliminating the multipath before you ever hear it. What little multipath distortion gets through this smart antenna system runs headlong into the remarkable tuner innovation *High Fidelity Magazine* described as *"...distinguished (by) its ability to pull clean, noise-free sound out of weak or multipath-ridden signals."*

Alone, without antenna diversity switching, the TX-Seven and TX-Nine's Asymmetrical Charge-Coupled FM Detector Circuitry delivers a *net noise and distortion reduction of 93.5%!* Together, they set a new standard for clear, clean FM autosound reproduction.

REAL WORLD CONFIRMATION. Both decks were tested on a torturous 6-mile course near the Carver factory which could regularly trigger at least *287 separate multipath occurrences* in conventional autosound FM tuners.

The TX-Seven and TX-Nine with Asymmetrical Charge Coupled FM Detection and diversity antenna system, reduced multipath occurrences to an average of *two* during the same course while listening to the same stations!

FACTORY–LOADED WITH EXTRAS. The fifteen random presets on the TX-Seven and TX-Nine are incredibly easy to set. Just press the button marked BEST and the logic circuitry *automatically* selects the fifteen strongest signals and locks them in on the presets. Plus you can select another fifteen on your own!

Naturally both decks are metal tape compatible with Dolby® noise reduction and have auto-reverse transports, separate bass, treble, balance and loudness and four-way fader controls. All tuning and transport functions are signalled with a gentle "beep" that keeps your eyes on the road, not on the compact, ergonomically-styled deck.

There's even a security code system that renders the TX-Seven or TX-Nine inoperable to anyone but you, and a quick removal system so you can slip out your TX-Seven or TX-Nine in seconds for storage in trunk or house.

THE BEGINNING OF THE PERFECT AUTOSOUND LISTENING ENVIRONMENT. Visit your Carver dealer soon and experience the TX-Seven and TX-Nine. Out of hundreds of the only tuner/cassette models available, they are the only ones which can truly put you in the driver's seat of a unique, interference-free musical experience.

Dolby is a trademark of Dolby Licensing Corp.

CARVER P.O. Box 1237, Lynnwood, WA 98046

POWERFUL MUSICAL ACCURATE

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Audio

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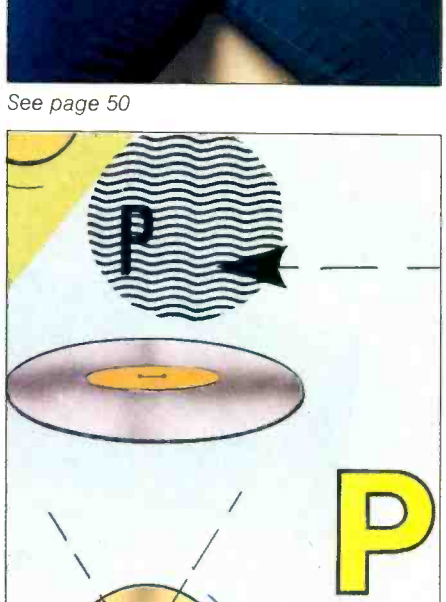

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MUSIC REVIEWS

DEPARTMENTS

The Cover Equipment: Magnavox CDB650 Compact Disc player.
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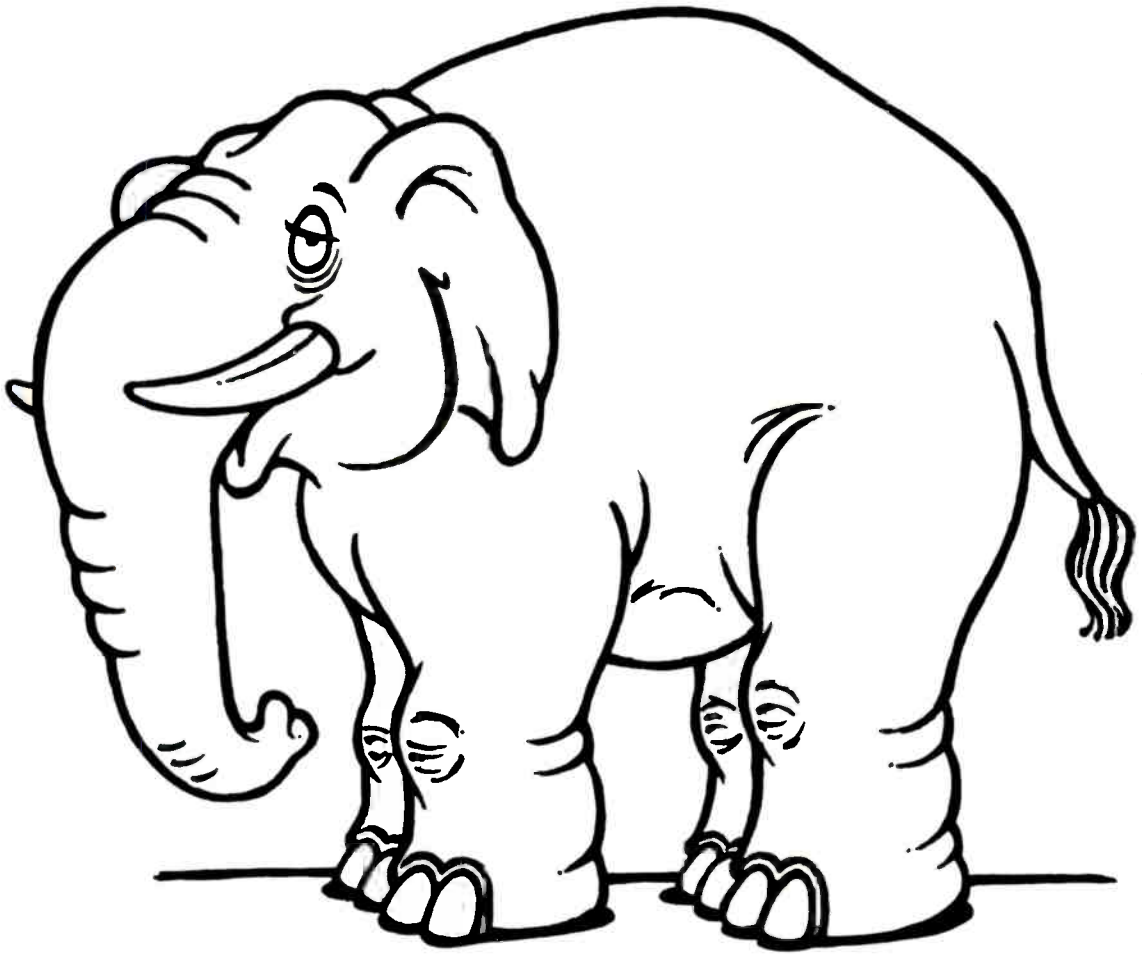
He's good. But can he remember 785 of your favorite songs?



This Magnavox compact disc player can. In fact, the top-rated CDB650 is the *only* CD you can program to play 785 selections. As you build your library, just program in your favorite selections from each disc in any order you want. The CDB650 will never forget them. Because it's the only CD with Favorite Track Selection. With FTS, the memory remains forever, even during power outages, even if it's unplugged. And it comes with full-function remote control.

With 4 times over-sampling and digital filtering, all you hear is the absolutely flawless reproduction of sound. What else would you expect from the people who invented CD technology?

The CDB650. Unforgettable.

Flawless sound. The ultimate memory.

Nobody puts it together like MAGNAVOX.

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Audio

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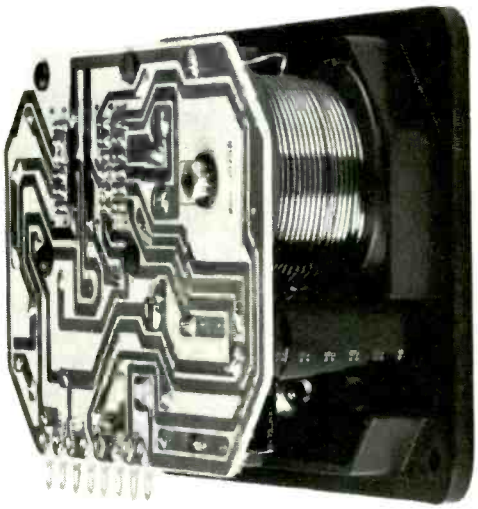
NO GUTS, NO GLORY.



▲ A different breed of crossover. All components are computer-grade and mounted on 'military spec' glass-epoxy board. Hand-built to rigid tolerances. Computer designed for smooth phase and frequency response. Results in precise imaging with remarkable breadth and depth.

▼ Series 2 soft-dome tweeter. Design fine-tuned by 16,000 data point computer analysis. Low-mass moving system and narrow magnetic gap for high efficiency and accurate transients. ADS High Gravity cooling fluid ensures exceptional power handling and dynamic range.

▼ Two new towers of power. L990 3-way and L690 2-way. Extra volume of tower enclosure provides deeper, more powerful bass. High frequency drivers set in line with the listener for lifelike, precise imaging. Similarly priced bookshelf speakers cannot compare.

The guts: Inside every ADS speaker you'll find drivers conceived, engineered, and built by ADS.

Conceived to be accurate, uncolored, and thoroughly reliable.

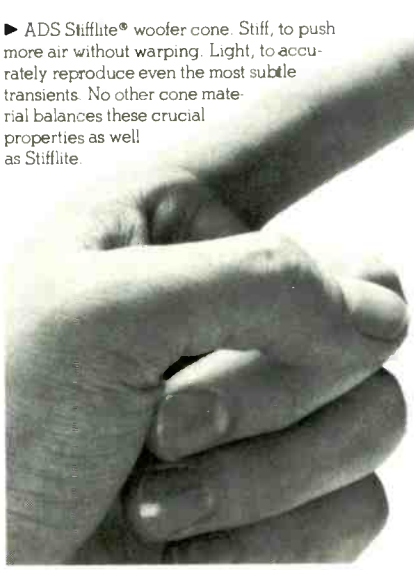
Engineered using proprietary computer analysis, to yield extraordinary performance.

Built with precision and care unequalled in Europe, the Far East, anywhere in the audio industry.

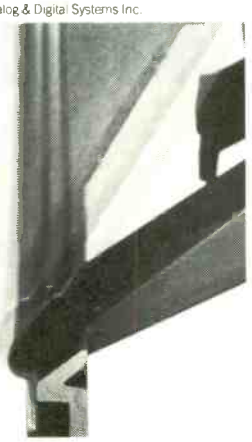
Not every speaker maker builds its own drivers. None builds them as carefully as we do. That's why ADS speakers are picked as reference monitors by the premier CD label. That's why the new level of accuracy CD provides can be heard best on ADS speakers.

The glory?

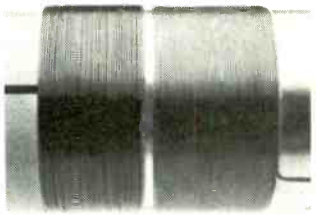
Waiting for you at your ADS dealer. Because while we can tell you how beautifully we build them, only he can show you how much better they sound.



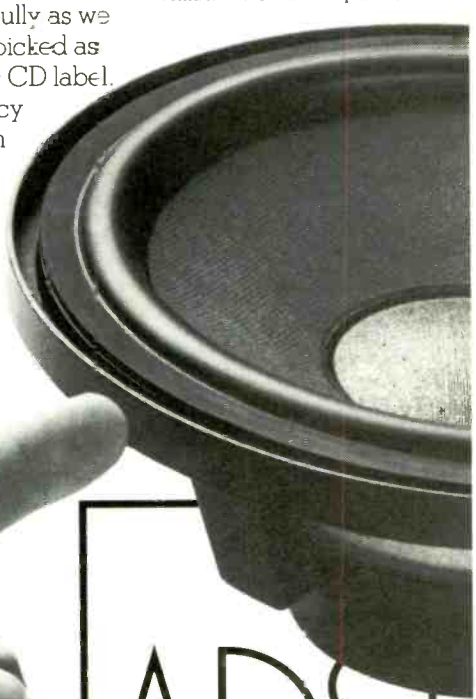
► ADS Stifflite® woofer cone. Stiff, to push more air without warping. Light, to accurately reproduce even the most subtle transients. No other cone material balances these crucial properties as well as Stifflite.



▲ The laws of woofer design present two options: cleaner deeper bass or just plain louder bass. ADS Linear Drive woofer plays deep and tight because cone travel is long and controlled. Takes full advantage of the wealth of bass on CDs. You'll not only hear the difference, you'll feel it too.



▲ Typical voice coil on left. ADS' version on right. Smooth, tight windings and longer coil mean accurate transients, low distortion. Coil always remains under strict amplifier control.



ADS

For more fascinating details on ADS speakers, see your local ADS dealer. If you don't know who he is, call us at 800-345-8112, in PA. 800-662-2444.

LEDE® Article Not Authorized

Dear Editor:

The two articles entitled "Build a Live End/Dead End Listening Room" in the December and January issues of *Audio*, authored by William R. Hoffman, constitute significant damage to the good name, trademark, and technical reputation of my client, Mr. Don Davis.

Mr. Hoffman is not an accredited Live End/Dead End™ designer. He has no connection with either Mr. Davis, Syn-Aud-Con, or any accredited LEDE® designer.

The article describes conventional absorption techniques and mislabels them LEDE. The techniques described are not LEDE design techniques and do not meet published LEDE criteria.

In the first article, in addition to the improper use of LEDE, each caption to each illustration is incorrectly labelled. Also, the room labelled "an LEDE demonstration room" is not remotely qualified.

We believe this is a case of trademark counterfeiting.

We request that *Audio* publish in equally prominent editorial space a full refutation of these articles as having anything to do with legitimate LEDE design.

We wish to reiterate that these articles constitute serious damage to our client's worldwide classes on LEDE by presenting a totally false picture of the design process.

Richard H. Montgomery
Montgomery, Elsner & Pardieck
Seymour, Ind.

Editor's Note: Mr. Davis has promised a full refutation of Mr. Hoffman's article for publication in a future issue.—*E.P.*

Calling All Collectors

Dear Editor:

I obtained brief details about *Audio* from the very helpful staff of the American Embassy in London. I hope that you can find a little space within the pages of your publication to mention what we are attempting over here in Great Britain.

Sounds Collectable was started last spring. The purpose behind this quarterly magazine is to provide space for private record collectors so that they may get in touch with one another and exchange information and records for the overall enjoyment of the hobby. We are endeavoring to build "a service for collectors—by collectors." In the main, this would cover hard-to-get and deleted-from-catalog recordings, ranging from 78s to the earlier micro-grooves. Musically, we wish to cover classical music (solo instrumental and orchestral) to, say, the Hollywood soundstage musical. We are nonsponsored and operate only in our spare time on a nonprofit basis.

Anyone—and we do mean anyone—living anywhere in the world can join in the fun. If any of your readers would like a sample copy of our somewhat primitive but (we think) friendly magazine, they only have to ask.

Russell Barnes
42 St. Leonard's Ave.
Blandford Forum
Dorset DT11 7NY
England

Taking Issue With Measurements

Dear Editor:

In your November 1986 issue, Len Feldman reported the results of his tests of the dbx DX3 CD player. While most of Mr. Feldman's measurements confirm our experience, two measurements, those of amplitude linearity and stereo separation, differed significantly from ours.

First, he reported that −80 dB signals were reproduced at −68.4 dB. Our measurements indicate that −80 dB signals are reproduced at levels very near to −80 dB when the signal itself—and only the signal—is measured. However, if a broad-band measurement is made, readings from −60 to −80 dB may be obtained because of the presence of out-of-band interference at 88.2 kHz.

As Mr. Feldman noted during his square-wave tests, the DX3 uses digital filtering with two-times oversampling and a gentle, third-order analog filter (for better phase linearity). The two-times oversampling produces an inaudible 88.2-kHz component which is attenuated to below −50 dB by the analog filter. A broad-band measurement of the −80 dB signal level will pick up some of this 88.2-kHz signal and result in erroneous readings. We are certain that the DX3's linearity is much better than was apparent from Mr. Feldman's testing.

Stereo separation is also subject to misinterpretation from the same cause, and we think that this too is the reason for the differences between Mr. Feldman's measurement of 65 to 54 dB separation and ours of 90 dB. We have measured channel separation of at least 90 dB in many DX3 CD players, and we believe that the same inconsequential out-of-band frequencies provide the answer to the question Mr. Feldman himself raised regarding his measurements.

It is interesting to note that proper testing of digital equipment requires not only greater resolving power on the part of the test equipment, to cope with digital's wide range and flat frequency response, but also extra care in the interpretation of test results. As Mr. Feldman himself has taken pains to point out, CD players, including the DX3, produce out-of-band components that can easily interfere with measurements but do not correlate with the audible performance which might be inferred from those measurements. We are still learning the best ways to measure digital equipment. This learning process is, after all, one of the things that keep audio (as a hobby and an industry) so interesting.

By the way, Mr. Feldman did express a desire to see dbx produce an accessory box offering compression for use with any CD player (especially for automotive use). Last June we introduced two such products for home use, the 1BX-DS and 3BX-DS, which offer compression as well as four other signal-processing circuits. Similar to that of the DX3, their compression is dbx's professional OverEasy (gradual-onset) circuit, variable from none to 2:1, with a fixed 6 dB of gain added to the lower end of the dynamic range. This compression is very useful when making tapes for the car as well as when using Compact Discs for background music.

Leslie B. Tyler
Vice President, Engineering
dbx
Newton, Mass.

ONE STEP IN THE MAKING OF A KEF

Anyone can build a good prototype. The real challenge is assuring the quality of everyday production. That's why KEF have the most stringent production test programme in the industry.

'We test each individual Reference Series driver for amplitude response with respect to frequency. The computer collates the tested drivers and crossovers into left and right pairs that match to better than ±0.5dB. This accounts for KEF's spot-on stereo imaging. Then we test the completed pairs for frequency and phase response against the original prototype.

'We keep all this data by serial number on permanent file. If a driver should ever need replacement, we can supply an *exact* duplicate.

REFERENCE MODEL 107

KEF

The Speaker Engineers

'Our testing may seem fanatical, but it's the only way to guarantee performance.'

—Frank Mesnicks, KEF PRODUCTION ENGINEER

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STEP UP TO Soundcraftsmen

MADE IN U.S.A.

STEP-UP to the demonstrably superior **PERFORMANCE** and unsurpassed **FLEXIBILITY** of our complete line of **AFFORDABLE** Stereo Separates. Audio components designed to complement, enhance and improve your present system.

Our new power Mosfet High Current and Class "H" Signal-Tracking Amplifiers, **all manufactured by Soundcraftsmen in the U.S.A.,** are the most advanced Stereo and Professional Amplifiers available. Our 205-watt amps begin at only **$449.00,** up to the massive **900**-watts-per-channel-@ 2-Ohms Pro-Power Eight, at less than 78¢ per watt!

Our four extremely versatile Preamplifiers range in price from **$299.00** to $699.00. These Unique Equalizer/Preamplifiers and Straight-Line Preamplifiers offer features such as – **97dB** phono S/N, **Exclusive Auto-Bridge** circuit for Triple-Powered Mono Operation of Stereo Amplifiers, and **Exclusive 0.1dB** Read-out Differential/ Comparator® Unity Gain Controls for precise in/out signal matching.

And for a real **"Musical High"** enhance your system with the addition of one of the World's Most Accurate Real-Time Analyzers or Equalizers. Not only the ultimate in Frequency Control capability (up to **22dB** gain per octave) but also a **100-LED** display panel **AND** an incredibly accurate **0.1dB** readout capability!

FOR A DEMONSTRATION, VISIT NEAREST DEALER LISTED BELOW

However, many additional Dealers—too numerous to list here—are located throughout the U.S. with many models on display. If no dealer is shown near you, or you encounter any difficulty, please phone us at 714-556-6191, ask for our *"Dealer Locator Operator."*

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A CONDENSED GUIDE LISTING FEATURES, SPECIFICATIONS, SIZES AND PRICES...

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PRO-POWER FOUR, MOSFET stereo power amp **300** Continuous RMS Watts per channel @ 4 ohms, 205 Continuous RMS Watts per channel @ 8 ohms, 20–20kHz, **450** Watts RMS @ 2 ohms, **900** Watts RMS @ 4 ohms Bridged. THD < 0.05%, Hum and Noise: –105 dB, Front Panel switching for 2 pair of speaker systems. 40-LED 0–1600 Watt Power Meters.
19"W x 5¼"H x 11"D, 30 lbs. **$749**

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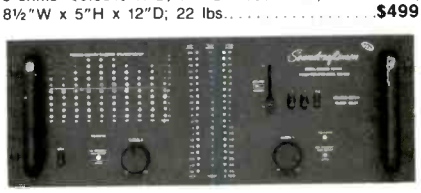
PRO-POWER EIGHT MOSFET stereo power amp. **600** watts per channel continuous RMS power into 4 ohms; 375 watts per channel continuous RMS power into 8 ohms, 20–20,000 Hz with no more than 0.05% THD; 900 watts per channel RMS into 2 ohms; Freq. resp. 20–20,000 Hz ±0.1dB; S/N –105dB; slew rate 50V/m.sec; TIM unmeasurable; IM 0.05%.
19"W x 5¼"H x 16½"D; 67 lbs. **$1,399**

PM840 Power Amplifier, MOSFET stereo, features no-current-limiting power supply, **300** w/p/c RMS into 4 ohms; 450 w/p/c RMS into 2 ohms; 205 w/p/c into 8 ohms @ <0.05% THD; Freq. resp. 20 to 20,000 Hz ±0.1dB; S/N >105dB; slew rate 50 V/microsec; TIM unmeasurable; damping factor 200.
8½"W x 5"H x 12"D; 22 lbs. **$549**

PCX-1, 5¼" x 19" Rack Mount/Cabinet kit, for PM840, shown installed. 11 lbs. **$49**

PCX-2 19" Rack Mounting kit for two PCR800 or PM840's, 2 lbs. **$49**

PCR800 Power Amplifier, MOSFET stereo, **205** watts per channel continuous RMS 20–20,000 Hz into 8 ohms <0.05% THD; TIM unmeasurable; S/N –105dB; 8½"W x 5"H x 12"D; 22 lbs. **$499**



DDR1200 Power Amplifier, with 100-LED frequency spectrum analyzer display. Features Class-H Vari-Portional circuitry; Autobuffer circuitry for continuous 2-ohm operation; 40-LED power output Meters from 0.02 up to 2,000 Watts; Truclip indicators for each ch; Mono Bridging switch on rear panel. TIM <0.02%; 250 W/ch into 8 ohms; **375** W/ch into 4 ohms continuous RMS, 20–20,000 Hz, THD <0.09%.
19"W x 7"H x 12"D; 52 lbs. **$1,199**

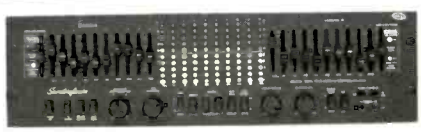
A5002 Power Amplifier, Class-H Vari-Proportional circuitry and Autobuffer for continuous operation into 2 ohms. Features auto crowbar protection circuit for output protection without current limiting; 40-LED 0–1,000 Watt power output Meters; Front-Panel switching for 2 pairs of speakers; True Clipping indicators; Input Level controls. Output power 250 W/ch into 8 ohms, **375** W into 4 ohms continuous RMS, 20–20,000 Hz at <0.09% THD; S/N >105 dB; slew rate >50 V/microsec; TIM <0.02%.
19"W x 7"H x 12"D, 50 lbs. **$899**

A5001 Power Amplifier, Same as A5002 except no Meters and no Input Level controls. 50 lbs. **$749**

A2502 Power Amplifier, MOSFET stereo with 40-LED 0–500 Watt power Meters. Features Front Panel switching for 2 pairs of speakers; Input Level controls; True Clipping indicators. Output power 125 W/ch into 8 ohms, **190** W/ch into 4 ohms, continuous RMS, 20–20,000 Hz at <0.05% THD; S/N >105 dB; damping factor 200.
19"W x 5¼"H x 10½"D, 30 lbs. **$649**

A2801 Power Amplifier. Same as A2502 except no Meters and no Level Controls, 28 lbs. **$549**

Signal Processors



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19"W x 5¼"H x 11"D, 21 lbs **$799**

DC4415 Third-Octave Equalizer, stereo with 21 controls/channel. Center frequencies 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1,000, 1,600, 2,500, 4,000, 6,300, 10,000, 16,000 Hz: Features EQ defeat; Infrasonic filter; Tape Monitor and Tape Record; Differential/Comparator® circuitry for Unity Gain setting to within **0.1db** accuracy for highest Dynamic Range capability. THD and IMD 0.01% at 2 V; S/N 114dB at full output; input imp 47,000 ohms.
19"W x 5¼"H x 11"D, 16 lbs. **$599**

DC2215 Differential/Comparator® Equalizer, Stereo 10-band, with Differential/Comparator® True-Unity-Gain circuitry for Input-to-Output balancing accuracy to within **0.1dB.** Equalizer filter circuits use precision wire-wound Passive-Coil inductors for high gain, low noise and distortion. Front panel controls include Tape monitor, LED defeat/EQ defeat and EQ Tape Record. THD and IMD <0.01% at 2 V; S/N ratio 144 db at 10V; boost/cut range ±15 dB, max 22dB. Includes Frequency Spectrum Analyzer Test Record, Computone Charts, Cables.
19"W x 5¼"H x 11"D, 17 lbs. **$399**

DC2214 Differential Comparator Equalizer. Same as DC 2215 except equalizer filter circuits have op-amp synthesized inductors. THD and IMD <0.01% at 2 V; S/N ratio 106 dB at 10 V; boost/cut range ±12 dB, max 18 dB.
19"W x 3½"H x 9"D, 13 lbs. **$299**

Preamplifiers

DX4200 Preamplifier/Equalizer, with Compact Disc Player and Video/Audio inputs. Phono preamp has Variable Cartrdige Loading (50–800 pF, 100/47,000 ohm); phono level controls for adjustable ±20 dB gain; MC variable reluctance or MM cartridge inputs; 3-way Tape Dubbing; 2 external Signal-Processor Loops; conventional line outputs plus separate Autobridge Line Outputs for Mono Bridging of Most Amps; EQ S/N 114 dB; Passive-Coil filters with 15 dB boost or cut for each octave, max 22 dB; Differential Comparator circuitry for True **0.1 dB** Unity-Gain EQ balancing; includes Frequency Spectrum Analyzer test record and instant reset Computone Charts.
19"W x 5¼"H x 11"D, 20 lbs. **$699**

DX4100 Preamplifier/Equalizer, with built-in conventional line outputs plus separate bridging line outputs for mono bridging of most amps. Features 2 external signal-processor loops; 2 phone inputs; 2 tape inputs with 3-way dubbing; phono S/N 97 dB, THD 0.01%; 12 dB EQ boost and cut for each octave, max. 18 dB; Differential/Comparator circuitry for **0.1 dB** Unity Gain; includes Frequency Spectrum Analyzer test record and instant reset Computone charts.
19"W x 5¼"H x 11"D, 19 lbs. **$549**

DX4000 Preamplifier. Same as DX4100 without graphic equalizer but with 3 external signal-processor loops.
19"W x 3½"H x 11"D, 15 lbs. **$399**

DX3000 Preamplifier, Inputs for CD player, Video/Audio, Tuner, Phono, Two Tape Decks with dubbing, Bass and Treble controls, and signal processor loop. THD –0.01%, S/N 95 dB.
19"W x 2⅜"H x 10"D, 10 lbs. **$299**

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T6200 AM/FM Stereo Digital Tuner Digital quartz PLL tuner with 16 Station presets, 5-digit Station Read-out, Auto-Scan tuning, active High Blend filter. Broad-Band AM switch, 19" rack-mount front panel. IHF sens 1.6 μV; S/N 75 dB; distortion 0.08%.
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TAPE GUIDE

HERMAN BURSTEIN

Vanishing Species

Q. Are there any companies left that produce a good, reliable 8-track record/playback deck?—Tim Ehler, Early, Iowa

A. The 8-track cartridge deck seems to have gone the way of Elcaset, quadraphonic equipment, and the dodo bird. It is extinct, or nearly so. The cassette deck has replaced it for reasons of performance, convenience, and reliability. The 8-track cartridge system was never considered a high-fidelity medium, whereas the cassette for some years now has become increasingly so.

However, a few 8-track cartridge *players* are still around. Radio Shack stores, for example, carry some.

Copying "Ancient" Discs

Q. I have inherited a pile of records of ancient vintage, including 78s, 45s, 33⅓s and 16s, as well as a number of cassettes. I have a record player (Garrard Zero 100) that operates at 45 and 33⅓ rpm, an open-reel deck that operates at 1⅞, 3¾, and 7½ ips, and a cassette deck that operates at 1⅞ and 3¾ ips. Is there any way to use my record player in the making of tape copies of 78s or 16s? And is there any way for me to use the tape decks to copy the cassettes?—John S. Carroll, Ventura, Cal.

A. To copy your 78s you will have to locate a turntable that operates at that speed. A few such are listed in *Audio*'s 1986 Annual Equipment Directory (October issue). Considering the age of your present turntable, it might be advisable to get a new one that incorporates the 78-rpm speed.

To copy your 16-rpm (actually 16⅔-rpm) records, play them at 33⅓ rpm, which doubles all frequencies, and dub onto tape (cassette or open-reel) at 3¾ ips. Then you can play the tape back at 1⅞ ips, which halves all frequencies, thus restoring the music to almost its original form. I say "almost" because equalization errors occur whenever a recording made at one speed is played back at a different speed. Because each frequency is doubled or halved by the change in playing speed, the playback equalization circuit applies the boost or cut that would normally be used for the frequency an octave higher or lower. In practice, however, the frequency deviations that result may not be bothersome, especially since so much of the material on 16⅔-rpm discs was not of spectacular fidelity to begin with.

To copy cassettes, play the cassette on your cassette deck at 1⅞ ips and copy onto the open-reel deck at either 3¾ or 7½ ips; 7½ ips is best. Play the open-reel copy at the chosen speed and dub onto your cassette deck at 1⅞ ips.

Dubbing-Deck Drawbacks

Q. I wonder if you can explain something that seems puzzling. I recently invested a considerable sum in a new stereo system which includes an excellent cassette deck. However, the deck does not have the facility to independently make copies of my friends' tapes, and I find this limits the usefulness of the system. I have noticed that many of the low-priced systems advertised by department stores these days offer dual cassette decks with high-speed dubbing. One would expect the more expensive components, such as mine, to offer more facilities. But it seems that very few of the audiophile-quality decks contain the dubbing facility. Why is this?

Auto-reverse is another feature offered by many of the department-store systems, but rarely by the audiophile-quality decks. It is rather galling to invest a good deal of money in equipment such as mine and then have to do without the useful facilities offered by much cheaper systems.—John Mason, Darien, Conn.

A. To make a cassette deck that works well in all respects—frequency response, distortion, noise, motion, essential features, etc.—requires much art and a substantial number of controls and annunciators which take a good deal of room. To get that performance with *two* decks in one frame—a dubbing deck—becomes a difficult, expensive, and nearly prohibitive task. To my knowledge, no dubbing deck has yet been acclaimed as matching the performance and features of sin-

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

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The new SDA 2As, like all the current SDAs, incorporate the latest 3rd generation SDA technology developed for Matthew Polk's Signature Edition SRS and SRS-2 including ***1:*** full complement sub-bass drive for deeper, fuller, tighter and more dynamic bass response; ***2:*** phase coherent time-compensated driver alignment for better focus, lower-coloration smoother, clearer, more coherent midrange and improved front-to-back depth and; ***3:*** bandwidth-optimized dimensional signal for smoother high-end and even better soundstage and image. The new SDA 2A is the finest sounding and most technologically advanced speaker ever produced at its extraordinarily modest price. It sounds dramatically better than speakers from other manufacturers that cost 4 times as much and more and is, at $499 ea., truly the speaker of your dreams at a price you can afford.

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Where to buy Polk Speakers? For your nearest dealer, see page 110.

Making a dubbing deck that works well in all ways is a difficult, expensive, and nearly prohibitive task.

gle-transport decks which merit the term high fidelity.

Dubbing decks are forced to take any number of shortcuts for reasons of cost and/or space. One of these is omission of noise reduction, either altogether or in part; if a dubbing deck does provide NR, it may offer only Dolby B NR, and not the more advantageous Dolby C or dbx NR. Such decks may not provide appropriate bias and equalization for all tape types. They frequently use automatic level control instead of the more desirable manually operated record-level controls; correspondingly, they may omit record-level indicators. They do not offer separate record and playback heads, which permit superior performance and the ability to monitor the tape as it is being recorded. And so forth.

To preserve high-frequency response requires very accurate azimuth alignment of the tape heads (i.e., keeping their gaps exactly at right angles to the long dimension of the tape). To do so in both directions of operation, in the case of an auto-reverse deck, becomes difficult and expensive. In the case of a "department-store deck" with auto-reverse, it is quite likely that its high-frequency response suffers.

If possible, I suggest that you compare the results of a department-store dubbing deck with the results obtained when you use your deck together with another high-quality deck to copy a tape.

At Home with Digital

Q. When will it be possible for the consumer to record digitally? Would cassettes be used, or some other medium? What might the cost be in the first year or two?—Ron Brinton, Plymouth Meeting, Pa.

A. Consumer digital recording systems have been available for several years in the form of PCM adaptors, which convert analog audio signals to digital and format them for recording on a VCR. Some 8-mm VCRs can also record digital soundtracks (or, in some cases, digital sound alone), but with a lower S/N and more limited frequency response (15 kHz) than CD players or PCM adaptors can achieve.

Digital audio tape (DAT) formats using cassettes smaller than today's analog cassettes have been developed for consumer use and may well become available in 1987. There are two proposed standards, involving stationary versus revolving heads, but it appears that the revolving-head (R-DAT) version will be the first, and perhaps only, one to reach the market. My best guess is that R-DAT machines will initially cost upwards of $1,000.

Recorders for digital audio disc exist, though in limited numbers and not in forms compatible with CD. One such recorder, for broadcasting, uses computer-type floppy disks and records for only a few minutes per side; another uses two-sided optical discs larger than the single-sided CD.

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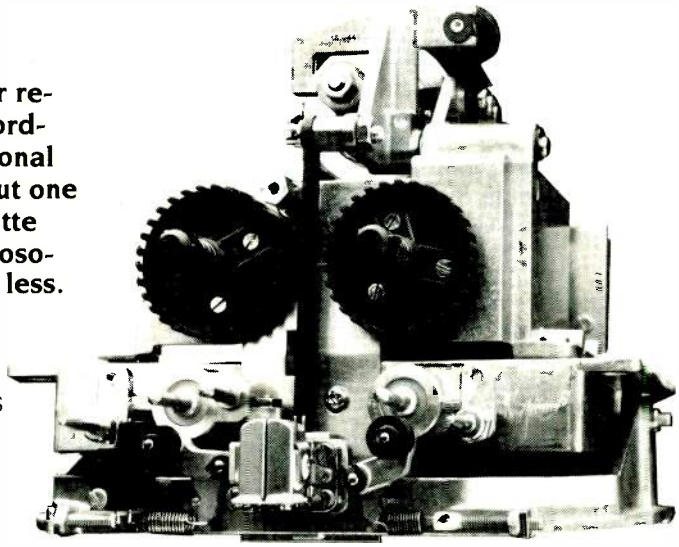

Studer Revox of Switzerland is the world's leading supplier of audio tape decks to recording and broadcast studios. Every transport we build adheres to the same strictly professional design criteria. The B215 is no exception.

1. A *Die-Cast Aluminum Alloy Chassis*–Stamped or rolled metal is not acceptable because it could warp or bend over time; also, it cannot be milled and drilled with the required precision. The B215 chassis reflects the same massive stability seen in every Studer Revox recorder right up through our $70,000 24-track machines.

2. *Direct Drive Motors*–The only alternative is belts and gears, both of which degrade performance over time. To avoid such compromises, the B215–and only the B215–has *four* tape drive motors: two quartz-locked Hall-effect motors for the dual capstans, and two microprocessor-controlled DC spooling motors.

3. *An Azimuth Stable Headblock*–This is difficult to achieve in the cassette format because the headblock must move in and out of the cassette shell. Nearly all other decks use an inherently unstable "sled" mechanism. But the B215 uses a pivoting die-cast headblock mounted on precision bearings (.001 mm tolerance) to assure the stability required for optimum high frequency response.

4. *Gentle, Safe Tape Handling*–An on-board microprocessor (one of three) monitors all tape motion in the B215. Optical servos govern the spooling motors to give constant winding speed, controlled tape tension, and smooth tape wrap. The motors gently slow the tape just before the end to prevent tape-stretching jerks. Tape damage of any kind is virtually impossible.

Such uncompromisingly professional transport design brings extraordinary performance to the home recordist: incredibly low wow-and-flutter, extended frequency response, and consistently repeatable results time after time, year after year.

For one astute listener's evaluation of the B215's sonic qualities, please note the review in Volume 8, #7 of *Stereophile*. Reprints are available on request to the address below.

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STUDER REVOX

AUDIOCLINIC

JOSEPH GIOVANELLI

Volume Settings with Remote Control

Q. I am using an equalizer in the tape loop of my integrated system. This equalizer is equipped with a remote control which enables me to adjust the volume of the entire system via the equalizer. At what approximate setting should I place the volume control on the integrated amplifier to achieve the best sound from the system overall?—Bill Jacques, Phoenix, Ariz.

A. I believe the exact setting of the volume control on your integrated amplifier is not critical. I suggest that you set it to a point where, with the equalizer's remote volume control adjusted to its maximum, the program level from the loudspeakers is just a bit too high. I suggest this setting to account for variations in volume among various program sources.

Feed-Through Capacitors

Q. I obtained a service manual for my CD player in order to gain a better understanding of its operation. I am puzzled about the nature and use of one component, shown to be a "feed-through" capacitor. The circuit boards are surrounded by a perforated cage, which I assume is used to shield the player's circuitry against r.f.i. or to prevent r.f. from escaping. The feed-through capacitors are mounted on the back of the cage. Within this cage are soldered wires which are really the audio output connections from the player. The capacitor extends through the cage, and the output cables are soldered to the capacitor terminals, which are on the outside of the cage.

These feed-through capacitors are definitely different from the output coupling capacitors, which are located on one of the circuit boards. Why are there feed-through capacitors when there are already output coupling capacitors?—Kenneth Beers Jr., Akron, Ohio

A. Feed-through capacitors are used as r.f. bypass capacitors. In your player, they are used to prevent any r.f. from the player from entering your audio system. They do not block d.c., as output coupling capacitors do. The terminal which connects the output signal from the circuit board to the terminal on the outside of the cage is really one straight piece of wire. Therefore, capacitance is not formed between the two terminals. Rather, it is formed between that wire and the surrounding conductor, which serves to mount the capacitor to the cage and also serves as its ground point.

Now that you understand how such capacitors are constructed, you can realize that their capacitance is very low, measuring only a few pF. Because of the low output capacitance of most CD players, the capacitive reactance offered by the feed-through capacitor won't affect the frequency response.

Separate Mono Amps

Q. What hardware is required for a system using separate monophonic power amplifiers for each of the two channels, as opposed to a stereo power amplifier? How must such a system be interconnected?—David C. Bennett, Elizabeth City, N.C.

A. There is no special arrangement needed just because a system includes two separate monophonic power amplifiers rather than a single stereophonic power amplifier. Make the connections in the same way that you would when connecting a stereo amplifier to the rest of your system. All you need are interconnecting cables. In the case of a stereophonic amplifier, the cable connecting it to the preamplifier may be a "two-in-one" type. Because of the physical separation between the mono power amplifiers, you may need two separate cables to make connections to them. If you are not involved with exotic bridging or special phase-reversing systems, this is all there is to it.

Amplifier Hum, Speaker Connections

Q. When I first turn on my music system, there is no hum; after a few minutes of operation, there is. This hum can be affected by the adjustment of the bass tone control. I have checked the tubes in my system, and they are all okay. Do you know what the problem is?

Also with regard to this music system, there are, on the back of the power amplifier, terminals to which the loudspeakers are to be connected. These are marked "Main," "8 Ohms," and "16 Ohms." My speakers are marked "Plus" and "Minus." I have another set of speakers, marked "Red" and "Black." How would I connect either of these pairs of speakers to this amplifier?—Bobby Ball, Dewitt, Va.

A. First, let's look at the hum problem. Sometimes, as tubes warm up, their electrical characteristics change. It may be that such changes are causing the hum. Many amplifiers and preamplifiers have hum-balancing adjustments. If your equipment has such a control, turn it a bit one way or the other and see whether this eliminates the hum.

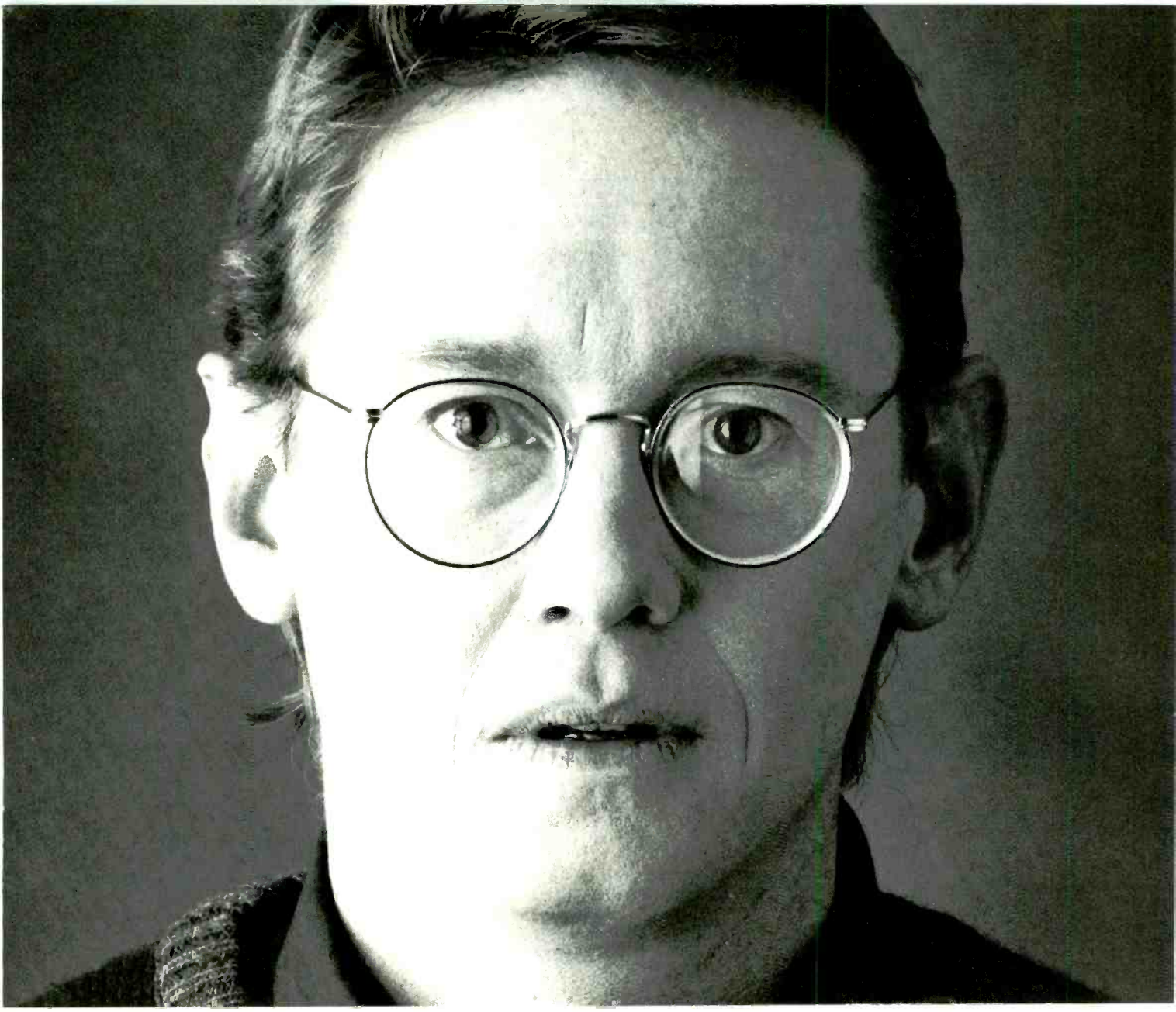
Not having heard the hum, I have no way of knowing whether it is 60 or 120 Hz. If it is 60 Hz, then it is most likely associated with the filament circuitry—as just discussed. If it is 120 Hz, then the power supply's electrolytic capacitors are involved. Such capacitors can change value when voltage is applied. It is not common, but I have seen it happen. If the amplifier is old, replace *all* of the filter capacitors in its power supply. Don't forget those interstage decoupling capacitors.

Your letter does not say if this is an integrated power amplifier. If you are using a power amplifier with a preamplifier, disconnect the power amp from the preamp and note if the hum still occurs. If it does not, you should concentrate your energies on the preamplifier, performing the same maintenance as described for an amplifier.

As for loudspeaker connections, the exact connections will depend upon the impedance of your loudspeakers. If their impedance is 8 ohms, use the 8-ohm connection. If 16 ohms, then the 16-ohm connection is to be used. In either case, consider the terminal which is marked with its impedance to be the "hot" terminal. The terminal marked "main" is the ground or common terminal.

Regarding the loudspeakers themselves, "red" or "plus" indicates the terminal to be used for the "hot" amplifier connection, and "black" or "minus" indicates the "common" connection to the power amplifier.

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.



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Some suggest that 40% to 50% of a basic system's cost should be allocated to speakers. Another formula is to spend twice as much for your speakers as your amplifier. Spend less and you probably won't realize the full potential of your system.

The issue is really one of value. Once you're in the proper price range, a little shopping will help you find the speakers that give you the most for your money. Compare various models for sensitivity, freedom from distortion, smoothness of response, wide dynamic range, quality of cabinetry, critical acclaim, a time-honored design – all are important characteristics. While you're shopping, you'll note that it's tough to find one speaker that wins in every category.

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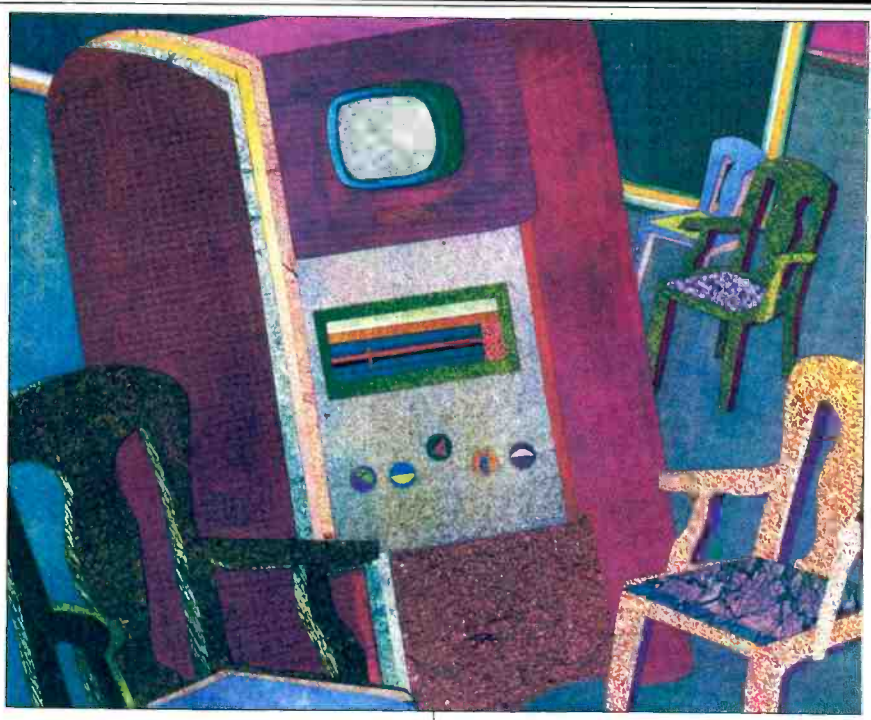

Illustration: Mary Jo Mazzella

I am slightly vague as to what species of audio was promoted for the first regular on-the-air television broadcasts in this country at the time of WWII—was it already FM? But I still retain my astonishment from that day at the voracious appetite for sheer bandwidth that this new broadcast monster displayed, in those early years when the rank and file of us first got to set eyes on a real TV picture with sound. Definitely there came the grand reorganization that ended old-band FM radio, as recounted here earlier. And in that big shake-up was created the present or "new" FM band, in the higher megs. It was plonked down right in the middle of the TV spectrum, with the numbered TV channels on both sides, which seemed very odd to most of us. If you tuned your new-band FM off the ends of the assigned frequency range, you could pick up TV audio. You still can.

What explained it was a matter of relative proportion. For that new FM, with its boasted "100-channel" profusion (I'm merely quoting the public arguments of the day), *one single TV channel* was pre-empted out of the baker's dozen set up. Within the confines of that single TV channel the *entire* FM radio spectrum was placed, complete as we know it today. Voracious is the word for TV.

If our modest little FM audio could now take over just the older, lower TV channels, excluding all of the higher UHF area, we could provide *many more than 1,000* full-width audio channels for FM radio, each one of them capable of everything in the way of hi-fi stereo that is now heard on the FM radio spectrum. Call it 100 to 1.

This, you can see, is one of those "all natural" physical setups which, like the laws that govern automobile speed and stopping distance, underlie vast areas of our daily activities. Of course, the professional broadcast engineer knows all about it, and the audio engineer too, if he has done his proper homework. But the public? Who knows. The exact figures are not important outside the lab; the general principle, though, explains a lot that we should know about broadcasting, and also, of course, about all the later formats for audio and video that involve recording and playback. Parameters differ. The basic relationship does not.

Video continues to demand enormous bands of available space as compared to audio by itself, minus picture, wherever we may turn, whatever the medium. Along with all the other factors put together, that single element in our "picture" has an enormous importance in determining the very shape of audio.

I have mentioned that after 1946, that turning-point year, the newly launched television operation began to take over for everything in consumer electronics, all the way from the 78 phonograph record to the movies. And somewhere, lost in the big shuffle, both AM and FM radio struggled to find even the simplest means for continued existence. It was a bizarre time indeed, though all the media eventually did survive. I think what needs to be said, then, is a bit about that early TV, back at its very beginning on our air—and here I can return to my own memories.

As you may easily guess, a lot of promoters or would-be promoters in the last pre-WWII years were aware that television was on the way and would likely become a big thing once the technical difficulties were solved for mass production. Exactly as in FM, the probability of war was not considered. Nobody wanted to admit the chance of an event as unsettling as *that*, and so business went right ahead (along with increasing "defense" preparations) straight from the fatal day for Poland in the autumn of 1939 until the war caught up with us on December 7, 1941. Two years of frantic development, in every non-military field you can imagine.

But TV really wasn't that far along. It was only black and white, of course—"only" being an anachronistic term, since we thought B & W was just fine. More important, TV began life in huge floor consoles that enclosed tiny little picture tubes almost ridiculously small. War or no war, TV wasn't yet ready to go *boom* on the economic scene. The war not only gave FM a lot of time to experiment but continued the existing—and huge—AM radio system for another five years, roughly speaking, before there was a major shift and TV came blasting in.

The pre-war promoters were right about TV's possibilities. But they seemed, abysmally, to have ignored one major factor, exactly as FM and Major Armstrong did. FM stations sprang up; applications for outlets piled sky-high in those late years of war denial. All these promotions as-

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Early TV sound? I wish I could say more. It was, all things considered, quite adequate in a mono sort of way.

sumed that the new media—FM or TV—would be theirs for the asking, once the moment arrived. What they all failed to see was that the existing networks and their close associates, like Ma Bell with its telephone cables, would grab television whole, to replace AM radio on a nationwide basis. There would be no room for the small operator, in either FM or TV.

And so, as I've mentioned before, the little FM station at which I worked was officially a would-be television outfit. I'll call it Metro Television, just to protect myself from long-departed ghosts. For our owners, FM was merely a way (to say it once again) to hold a place on the air, to keep a foot in the broadcast door. What else? There was indeed television during the war. But it didn't come from us. We purveyed the finest existing audio—and that was it.

Now, we did indeed have to do *something* to make ourselves look vaguely like a television station. After all, there was our public image to consider. So one day, shortly after I hove on the scene with my first radio programs, a monster console appeared in our downstairs reception room. It was a television set! ("TV" had not yet become a common term, nor the British "telly.") It was RCA's very best, with the aforementioned tiny tube, I think maybe 6 inches diagonal, protruding through the startlingly large front area of the furniture housing. Did they really need all that console space? With tubes, probably yes. Television demands, or did demand, space in more than one way.

None of us had ever set eyes on actual TV before, some 20-odd souls including the station engineers and announcers. So you can imagine the impact of that thing, sitting right there where everyone had to pass it to go anywhere at all. It was, as they say, the cynosure of every eye. Including mine. You will, of course, understand that even in the busiest of offices or studios there is a vast amount of play, so to speak. Times of waiting, of indecision, of coffee breaks and restroom visitation plus plenty of just plain goofing off. That television was *very* well patronized—and not by the outsiders who were supposed to be impressed. It ran all day and evening for *us*, so long as there was a broadcast signal.

At first, I glanced only casually, sat down and looked a while, then went about my business. But as we know, television is insidious, even a 6-inch diagonal. To lose your attention, it has to get down almost to postage-stamp size. My attention began *not* to be lost. I'm always aware of and interested in the way media are used for effective, i.e. dramatic, presentation. I became fascinated with TV, but not, as you will be thinking, because of its astonishing power. It was exactly the opposite—its uncanny ineptitude at that stage of its existence. You wouldn't believe it.

Have you any idea how far television, with all its enormous faults and its pall of vacuity, has actually come from its beginnings as a communications medium? Beyond belief.

The few stations then on the air were, of course, network. The big radio powers had set up pilot plants, so to speak—not merely in FM radio, as was necessary for the smaller aspirants, but in actual TV. The networks could do it—we couldn't. These pilot stations were, exactly as we were in FM, noncommercial, on a very small scale, operated by hook and by crook on tiny sustaining budgets. But they were *there*, on the air, and they could populate the few existing publicly sold receivers with actual pictures.

What you saw, then, aside from early newscasting (just a man reading a script against a blank background) was what amounted to a small apartment, rebuilt into a makeshift studio. There was a main "stage" or room, and various doors, always the same, giving access to some very restricted areas behind stage. I sensed that there must be at least 3 feet of cramped closet space back there, where the participants—the actors and performers and whatnot—had to conceal themselves, and from which they made their entrances and exits.

Scenery? The most rudimentary, on the order of a very amateur improvised theatrical show. A drape here, a chair and table, a couch, maybe one picture on a wall just to look homey. No outdoor scenes. We didn't have TV outdoors, short of some enormous van full of equipment—and it was not a time to set up that sort of thing.

Sound? I wish I could say more. It was, all things considered, quite adequate in a mono sort of way. Yes, the people talked. That was the essence of TV. And it was live, as the movies were not. Straight from the station in real time, never recorded. (That came later.) If a man spoke to you, he was right *there* at the very moment, perhaps a few blocks away down the street. That gave a new immediacy that reached its greatest impact when the big sports broadcasts came in, years later.

So just picture the scene as I watched that little screen in the late '40s, in the lobby of Metro Television, the FM station. The set is tuned to CBS and on comes a drama—a radio play, only now it has pictures. There is that blank wall again, maybe with a different picture, the same old chair and couch and table—and those doors. Out of door left comes actress A. She spouts her lines to actress B, emerging from the right door. After a bit, the plot calls for somebody else and out he comes from the same old place, that all-but-visible closet behind. Actress A is finished—she retires back into her door on the left, and the play goes on. I am hypnotized. Because, minute after minute, time passes and *there she is*, actress A, scrunched up inside that stifling closet behind the left door! Will she ever get out? She *has* to be there. When the poor soul finally emerges, I give a sigh of relief—I thought she might suffocate.

That, repeated a thousand times, was TV drama in the '40s. In a few days you got to know every cranny of those foursquare studios, all too obvious and immovable, always the same. It was awful. There *was* no television technique; they just didn't know what to do with the medium.

Then one day, to my astonishment, a live show came on featuring two musicians at two keyboards—and suddenly, marvelous angle shots of hands, fingers, heads, a pure fantasy to real, live music. I was entranced. I immediately wrote an enthusiastic letter to CBS TV, all 15 feet or so of it in that studio. Do you know, a few days later I got a perfervid reply from the station crew, almost weeping with thanks. It was the rare viewer like myself who kept the CBS TV people faithful to their art through such perilous times! I wish I had that letter now. It bore, I thought, the marks of tears.

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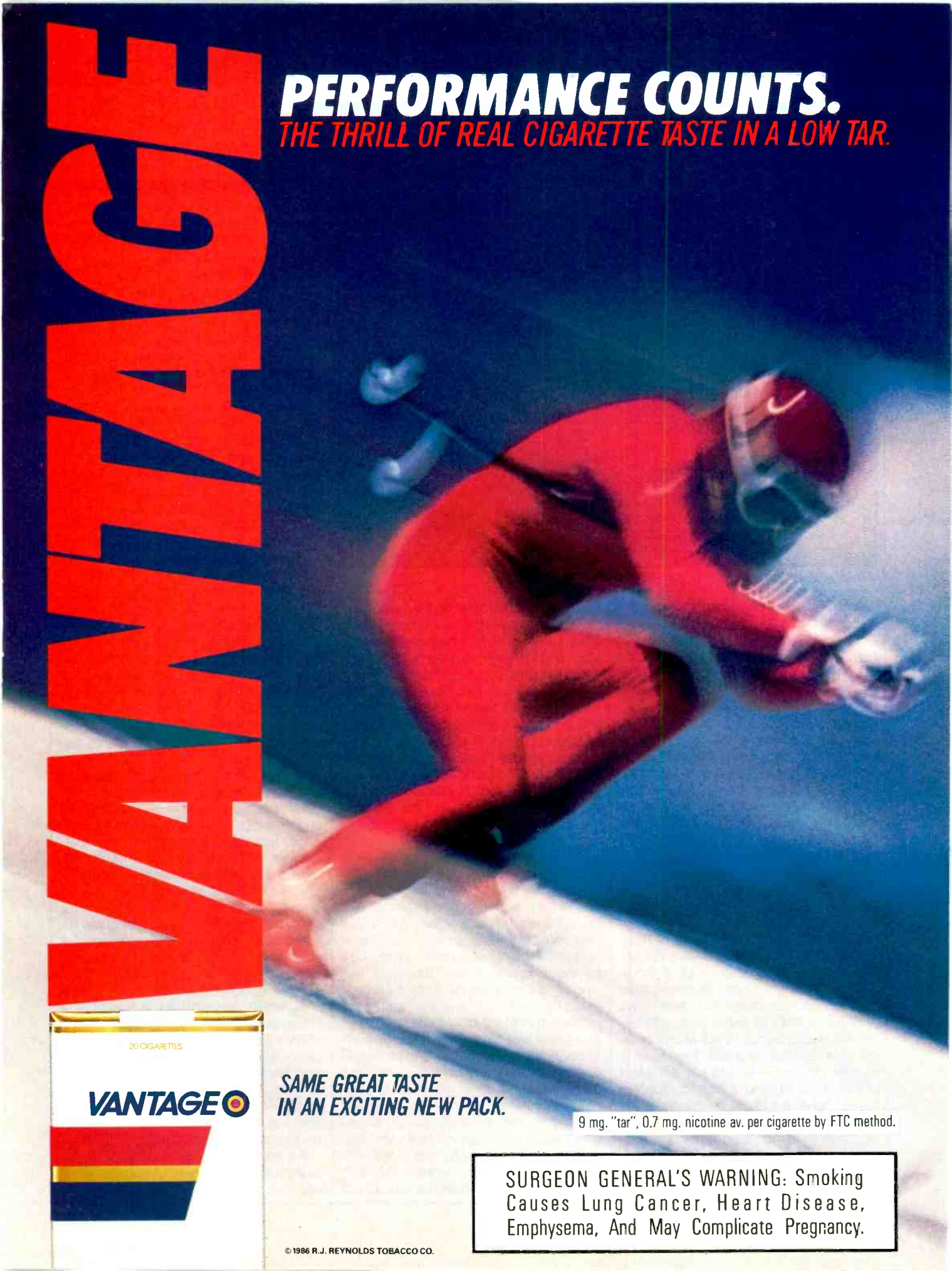

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BERT WHYTE

THE RIGHT OF ASSEMBLY

An ML-7A preamp being tested in the Levinson facilities

Over the years, certain products have earned a reputation as the very best that money can buy, and their names have become synonymous with high quality. One of the most obvious and best known of these products is the legendary Rolls-Royce motorcar; others in this exalted category are such sybaritic essentials as Purdy shotguns and Patek Philippe watches. People buy these ultra-expensive products because they are precision-made from the very finest materials, with much hand-crafted construction and immaculate finish. Another allure of these products is their long-term reliability and performance, their sheer elegance, prestige and pride of ownership, and, admittedly, even snob appeal.

In the relatively short history of high-fidelity sound, no audio component has attained the lofty stature of a Rolls-Royce. However, since the emergence of high-end electronics, there have been a number of expensive, well-designed audio components whose makers have aspired to a very high level of quality. I think it is safe to say that Mark Levinson is among those companies which have assiduously pursued the goal of making audio components with uncompromising standards of high quality. Having used a number of Levinson units for some years, I have always been interested in their technical aspects and how they were made. Recently I was invited to visit the new Mark Levinson plant in Middletown, Connecticut, and herewith are some of my impressions and experiences.

The Mark Levinson plant occupies 30,000 square feet of space in several modern buildings situated on 12 acres of park-like land. The buildings contain the administrative offices, laboratories, and production facilities for all Levinson products. The complex is also the headquarters for Madrigal Ltd., the distributing company for Mark Levinson products as well as importer of audio components from Meridian, Accuphase, Jadis, Cabasse, Lurné, and Carnegie. The buildings were formerly owned by a French oil-exploration company, and one of them has concrete walls and a concrete floor several feet thick! This is now undergoing renovation as the new Levinson sound room. Obviously, this kind of structure will avoid all diaphragmatic flexure!

Chairman of the board Sanford Berlin and president Mark Glazier guided me through all the Levinson facilities while explaining their philosophy. They are committed to the manufacture of musically accurate preamps and power amplifiers, not to units which sound good because of some "pleasant" coloration. This philosophy was further expounded on in discussions I had with chief engineer Kevin Burke. He admitted that it was a decided advantage, in developing new designs and circuit topology, to be relatively free of cost constraints. With costs subsidiary to results, a more open-minded, aggressive, and exploratory attitude towards innovative ideas and topologies is possible, always with the goal of optimum performance.

The first stage of manufacturing for all Levinson products is a check of incoming parts. Many high-quality parts are used, and a number of them are purpose-built for Levinson. These include special high-precision potentiometers and toroidal transformers. High quality notwithstanding, all parts are checked for dimensional accuracy, electrical performance, and adherence to specifications. Tolerances for resistors and capacitors are checked and matched where desired.

Levinson makes all of their own high-precision p.c. boards. These are assembled from the inspected parts, then individually or wave soldered, and then inspected with high-power three-dimensional microscopes for shorts or other flaws. The p.c. board work is as good as or better than Mil-spec, and in fact the plant can qualify for military defense production. All Levinson products are hand-crafted, with teams assigned to make p.c. boards and other subassemblies for a specific product. All subassemblies are electrically and mechanically checked from approved engineering blueprints and samples. Thoroughness extends to documenting the assembly history of each p.c. board lot. All metalwork—including chassis, faceplates, heat-sinks, etc.—is checked for dimensionality to ensure accurate assembly, and particular attention is given to Levinson's special anodizing treatment and engraving. Faceplates are rejected if even the tiniest flaw is detected.

A team assembles a particular preamp or power amplifier, and then elaborate testing to specifications begins. After a burn-in period, thermal and electrical cycling of the unit is performed. A final check of specifications and inspection of metalwork is done, and the unit undergoes listening tests at operating temperature.

As you might expect, laboratory research into all aspects of audio is virtually the lifeblood of a company like

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THE CARVER M-500t MAGNETIC FIELD POWER AMPLIFIER LEADS AN INDUSTRY TREND TOWARDS MORE USEFUL DYNAMIC POWER FOR MUSIC...AND YET STAYS WELL AHEAD OF ITS INSPIRED IMITATORS.

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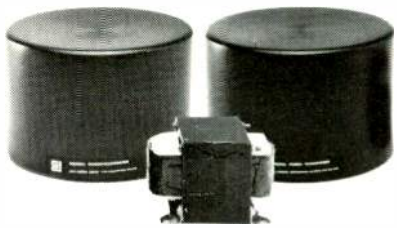
POWER EXPRESSED BY THE DEMANDS OF MUSIC. The Carver M-500t responds to musical transients with 600 to 1000 watts of dynamic power, depending on speaker impedance. The gulf between FTC and dynamic power ratings reflects Bob Carver's insistence that amplifier design should fit the problem at hand: The need to reproduce music with instantaneous, stunning impact.

The individual leading edge attack of each musical note lasts less than 1/1000 of a second, yet forms the keen edge of musical reality which must be present if true high fidelity is to be realized. It is especially necessary with the increased dynamic capabilities of Compact Discs and video Hi-Fi. In ordinary amplifier designs, the vast amounts of power required is provided by bulky, expensive power supplies and huge output transformers.

THE MAGNETIC FIELD AMPLIFIER SOLUTION. Rather than increase cost, size and heat output with massive storage circuits, Magnetic Field Amplification delivers instantaneous high peak and long-term power from a six-pound, four-ounce Magnetic Field Coil. Shown below are the 40-pound toroid coils from a pair of $7000 esoteric power amplifiers. In front of them is the M-500t's Magnetic Field Coil capable of delivering TWICE the output current (±100 amperes at 10% regulation!) for exceptionally precise control of voice coil motion.



Thus Carver's remarkable, patented design not only lets you enjoy the stunning sonic benefits of simultaneous high current and voltage in a compact, cool-running component, but enables you to afford audiophile-level power as well.

POWER WITH FINESSE. While the M-500t isn't the only amplifier with aggressive output capabilities, it is one of the few that tempers brute power with sophisticated protection circuits beneficial to both the amplifier and your loudspeaker system. These include DC offset, short circuit and power interrupt systems, as well as two special computer-controlled speaker monitor circuits which protect against excessive high frequency tweeter input and overall voice coil thermal overload.

Output is continuously monitored through dual lighted infinite-resolution VU-ballistic meters which can react to musical transients as brief as 1 millisecond.

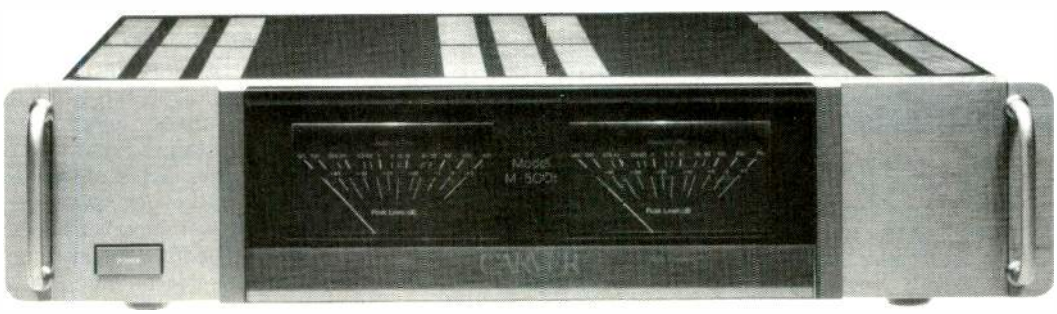
In addition, the M-500t's lack of external fan noise is complimented by internal circuitry with the best signal-to-noise ratio of any production amplifier: Better than 120dB. And, unlike any other amplifier in its price or power ranges, the M-500t is capable of handling problematic speaker loads as low as 1 ohm. It may also be used in a bridged mode as a 700 watt RMS per channel mono amplifier without any switching or modification.

MUSIC IS THE FINAL PROOF. Specifications aside, final judgment of any amplifier must be based on musicality.

Bob Carver has carefully designed the M-500t with a completely neutral signal path that is utterly transparent in sonic character, resulting in a total lack of listener fatigue caused by subtle colorations exhibited by many other amplifiers, regardless of their power rating. A veil will be lifted between you and your musical source as the most detailed nuances are revealed and delivered with proper impact.

We invite you to audition the M-500t at your nearest Carver dealer soon. Against any and all competition. We believe that you will be pleasantly surprised at just how affordable this much power, musicality and accuracy can be.

SPECIFICATIONS: POWER, 251 watts/channel into 8 ohms 20Hz to 20kHz, both channels driven with no more than 0.15% THD. Instaneous Peak power, 1000 watts into 2 ohms, 950 watts into 4 ohms, 600 watts into 8 ohms **Long Term Sustained RMS power,** 500 into 2 ohms, 450 into 4 ohms, 300 into 8 ohms, 1000 watts bridged mono into 4 ohms, 900 watts bridged mono into 8 ohms **Bridged Mono RMS Continuous Power,** 700 watts continuous into 8 ohms **Noise,** −120dB IHF A-Weighted **Weight,** 25 lbs



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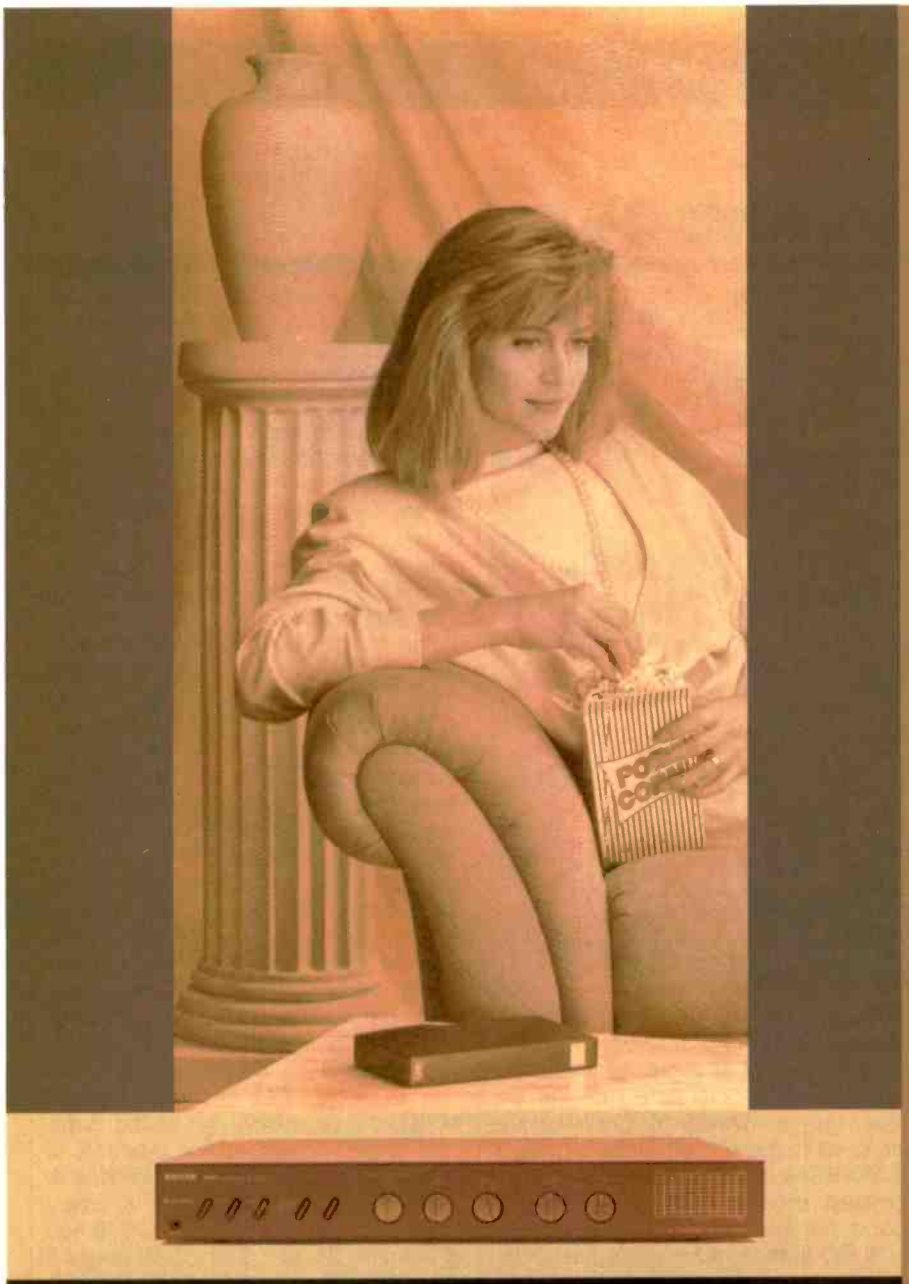
As might be expected, laboratory research is virtually the lifeblood of a company like Levinson.

Levinson. Levinson is enjoying great success with its new flagship amplifier, the pure Class-A Model 20, a direct development of this time-consuming research. Even at $9,600 per monoblock pair, Levinson is selling all the Model 20 amplifiers they can make, both in this country and abroad. The Model 20 embodies much innovative circuitry, including high-current, low-impedance driver stages; a precision thermal-tracking bias circuit; a heavily biased, low-impedance output stage, and a highly refined soft-clip circuit. Further technological advances include a high-current-capacity unregulated power supply, with separate components for positive and negative lines ("rails"); fully electronically regulated, independently tracking power-supply rails for all stages, including the output; extensive bypass capacitor techniques; the elimination of impedance-smoothing output Zoebel networks to maintain a high damping factor over a wide bandwidth, and full protection and dissipation circuitry which does not interfere with sonic performance. The Model 20 has a rated output of 100 watts into 8 ohms and 200 watts into 4 ohms, and will deliver 400 watts into 2 ohms with a THD of less than 0.4%.

Levinson's newest amplifier is the Model 23. A dual-monaural design on a single chassis, it incorporates many of the refinements that resulted from research on the Model 20. The Model 23 is a Class-AB amplifier with a rated output of 200 watts into 8 ohms and 400 watts into 4 ohms. It has a current output of about 50 amperes. Part of this is due, no doubt, to the hefty 1,250-VA toroidal transformer. The Model 23 employs a modest amount of negative feedback and can safely operate into load impedances as low as 1 ohm. Its price is $4,400, and it will be available as you read this.

I listened to the Model 23 and found it an exceptional performer, with tight, deep bass, a good sound stage, and a lovely, smooth top end. However, good as it is, it simply isn't in the ultra-performance league of the Model 20. I had the Model 20 at home, teamed with the great ML-6B preamp, and I drove Duntech Sovereign loudspeakers with it, using MIT double "shotgun" speaker cable. This combination produced a truly extraordinary sound, with extremely clean bass reaching down to subterranean levels, a very broad sound stage, depth that clearly delineated the layers of the orchestra, and the most refined, sweetest, smoothest, and most harmonically correct top-end I have heard from any amplifier. On the evidence of the Model 20's sound, one has to conclude that the extensive research devoted to this truly musical amplifier, and the expensive, painstaking, hand-crated construction that went into it, have paid off handsomely.

Now if we could all just find a way to win the lottery . . . !



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"...much higher quality of sound than in most Dolby Stereo theater installations."

–Audio

"...a decoder...that sets a standard in this field."

–Stereo Video Guide

"...designed to duplicate quite closely the exact relationship found in the sound track of the movie."

–The New York Times

"...guarantees Dolby surround as well as stereo and mono synthesis with... adjustments to match... any room."

–Chicago Tribune

"...includes a directional circuit which increases the directional perception of the strongest signals. This is the innovation that truly distinguishes the Shure unit from all the others."

–Suono

"It seems to do just about everything necessary for the reproduction of current Dolby surround-encoded films, as well as spatially enhancing the playback of conventional stereo and mono..."

–Sound & Vision

"...logic circuitry makes the performance of the Shure HTS 5000 very close to that of a professional Dolby Stereo system."

–AUDIOreview

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KEN POHLMANN

MINDING YOUR P's AND Q's

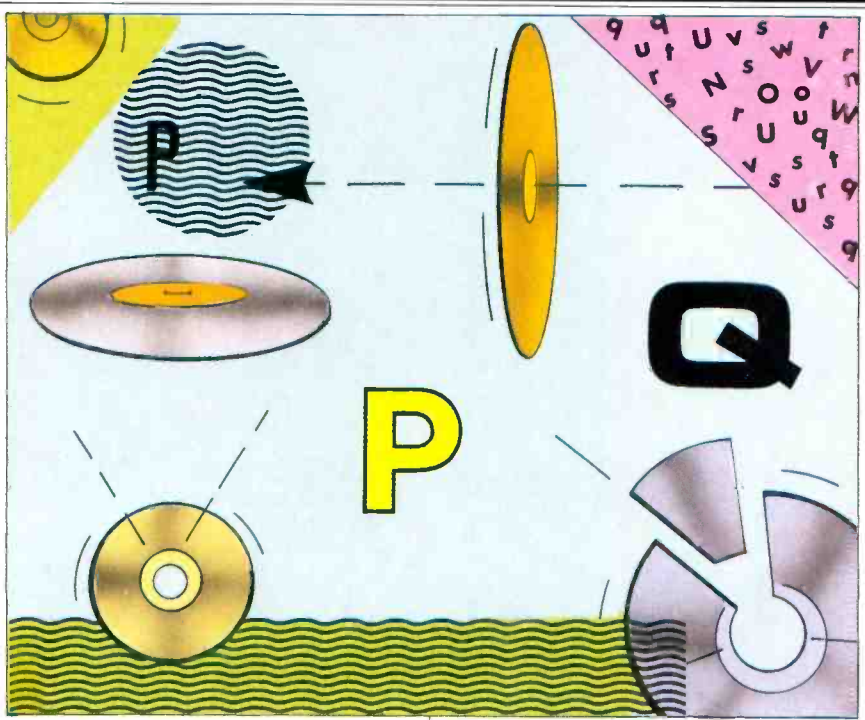

Illustration: Zoë Brotman

If you read this column regularly (and I know you do), you've followed me through some of the startling twists and turns of emerging Compact Disc technology. Recently, we've observed that the CD-ROM and CD-I formats will promote the Compact Disc in entirely new markets, to entirely new users. For example, corporate data bases, telephone books, automobile navigation, and interactive fiction could all be considered candidates for that 12-cm disc.

In order to appreciate some of the potentials of the emerging CD formats, it's important to shed the stereotypical (pun intended) ideas of what a disc can and cannot do. An often overlooked part of the CD system, the subcode, can help demonstrate the open-ended nature of the format.

To begin our perspective-broadening exercise, try to purge yourself of all thoughts of LPs and tapes. Those analog audio-storage media are far removed from the bit stream encoded on a CD. Try not to think of the CD as an audio medium at all. Rather, consider it as general storage for numerically represented information. The fact that most CDs today have used an audio signal to modulate the bit stream is happenstance. The CD is simply a random-access, stand-alone, compact storage medium. Similarly, think of your CD player as more than an audio component. It is a data retrieval device; only a minority of its circuitry is devoted to the analog audio signal. In a CD-ROM drive, the audio section is omitted entirely and replaced by a computer interface.

A CD is thus much more than a recording. It contains an encoded data structure complete with all the information the player requires to decode the contained data. Many of the player's operational features—such as timing, addressing, and indexing—derive their intelligence from special control information encoded on the disc. The control information is hidden in the subcode on every CD.

All data on an audio CD is arranged into frames, as shown in Fig. 1. The frame structure is used to distinguish among audio data, parity information, the synchronization word, and the subcode. The 27-bit sync word, both 96-bit data words, both 32-bit parity words, and two of the eight subcode bits are all used on a disc for audio reproduction.

The eight subcode bits contained in every frame are assigned letter designations from P through W, and are collectively referred to as the PQ subcode. In the audio format, only the P and Q bits are used; the remaining six bits comprise the "user field" and are available for other applications. The eight subcode bits are used as eight different information channels, with each frame containing one P bit, one Q bit, one R bit, etc. Since there is only one subcode bit per channel in each frame, subcode data is assembled eight bits at a time, from 98 successive frames, to form a subcode block (Fig. 2).

The start of each subcode block is signalled by a synchronization word consisting of two sync patterns, S_0 and S_1. Because the signal has already undergone a process called eight-to-fourteen modulation (EFM) by this point, these are 14-bit patterns. There are 267 "legal" EFM patterns, but only 256 of them correspond to possible values for the eight-bit data which existed before EFM encoding. The S_0 and S_1 patterns are two of the 11 EFM patterns which have no eight-bit equivalents; this ensures that the sync patterns cannot be confused with subcode data during playback.

Subcode data accumulates at a rapid rate. Each CD channel contains 44,100 16-bit (two-byte) audio samples every second, so the byte rate is 44,100 × 2 × 2, or 176.4 kilobytes/S. There are 24 audio symbols in every frame, so the frame rate is 176,400 divided by 24, or 7,350 Hz. Because it takes 98 frames to make one complete subcode block, the subcode block rate is 7,350 divided by 98, or 75 Hz. That is, there are 75 subcode blocks every second.

Figure 3 shows some of the information contained in the P and Q subcode channels of an audio CD. The P channel primarily carries flag bits used by the player to control the optical pickup. These flags designate the start of each track and the lead-in and lead-out areas on the disc. The lead-in and lead-out signals tell the player where the music program begins and ends.

A repeated pattern of ones in the P channel indicates that the next track is about to start. This start-flag signal is equal in length to the pause between tracks but is no shorter than 2 S; if a pause of less than 2 S occurs between two tracks, the start flag will begin before the first of those tracks has ended.

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326629. Bruce Springsteen—Born In the U.S.A. (Columbia)

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316604. Tchaikovsky: 1812 Overture; Marche Slave; Beethoven: Wellington's Victory. Lorin Maazel, Vienna Phil. *(Digital—CBS Masterworks)*

343251. Bach: Goldberg Variations. Glenn Gould. *(Digital—CBS Masterworks)*

287003. Eagles—Their Greatest Hits 1971-1975. *Lyin' Eyes; Take It To The Limit;* etc. (Asylum)

346767. Johnny Mathis—Most Requested Songs. *(Digitally Remastered—Columbia)*

337519. Heart. Top 10 Album. *What About Love; Never;* etc. (Capitol)

321570. Beethoven: Symphony No. 5, Op. 67; Schubert: Symphony No. 8. Lorin Maazel, Vienna Phil. *(Digital—CBS Masterworks)*

333286. Phil Collins—No Jacket Required. Album of the Year! (Atlantic)

348649. The Pachelbel Canon And Other Digital Delights. The Toronto Chamber Orchestra. *(Digital—Fanfare)*

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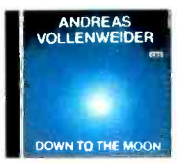

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Try not to think of the CD as an audio medium at all. Rather, consider it as storage for numerically represented information.

If one track is cross-faded into another, with no intervening pause, the start flag begins 2 S before whatever point the producers consider the start of the second track. The player counts start flags to locate any particular track.

During audio tracks, the P subcode channel carries a series of zeros, except when the start flag for the next track has begun. The lead-in is also encoded as a series of zeros in the P channel. The lead-out includes both repeated ones and zeros, alternating at a 2-Hz rate.

The Q code is more sophisticated. Each Q-channel subcode block (Fig. 4) contains 72 bits of Q data plus 16 bits of CRCC (cyclic redundancy check code) used for error detection, four "address" bits, four bits of control information, and two sync bits.

Of the four control bits, only three have defined uses so far. Bit 1 indicates whether the recording has two or four channels, allowing for players which would automatically switch their outputs from stereo to quadraphonic sound. (I know of no such players yet.) Bit 2 is undefined. Bit 3 is used to permit or deny digital copying; it can be used to activate or disable the CD player's digital output or could regulate the ability of digital recorders to copy the CD's data directly. Bit 4 indicates whether the current track is encoded with pre-emphasis, a high-frequency boost used to reduce noise; if pre-emphasis is in use, Bit 4 switches the player's de-emphasis circuits on to restore flat frequency response.

The "address" bits tell the player how to interpret the 72 bits of Q-channel data which follow. So far, three interpretive modes have been established.

A Mode 1 Q-channel data field always contains track numbers, time within the track, and absolute time from the beginning of track 1; it also contains other information whose meaning depends on whether it occurs during the lead-in or during the music. In the program areas, Mode 1 indicates that the Q-channel data contains index numbers within the track, as well as the timing information. During the lead-in (track 00, absolute time 00:00), it indicates that the Q channel contains the disc's table of contents (TOC), which tells how many tracks there are (up to 99), how long each lasts, and their starting times (measured from the beginning of the disc). The TOC is repeated continuously throughout the lead-in, and the data is repeated three times in each TOC. This information is read during disc initialization, before the disc begins playing, so that the player can respond to any programming or program searching that is requested by the user. Also, most players can display this information.

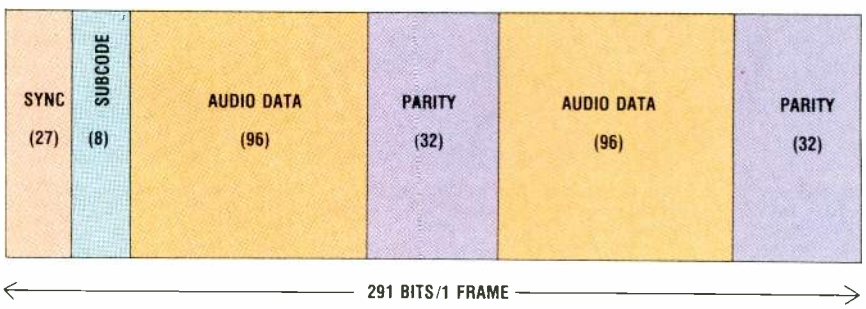

Fig. 1—One frame of data on an audio CD, before EFM encoding.

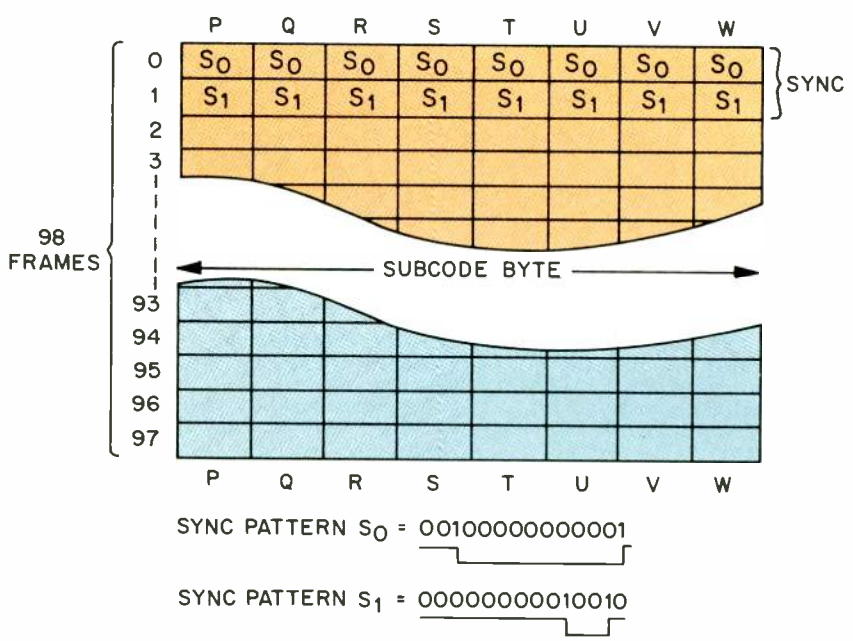

Fig. 2—A subcode block is assembled from the subcode bits of 98 successive data frames before being divided into 98-bit frames for each subcode channel. The beginning of each block is marked by two unique sync patterns.

THE INS AND OUTS OF A SONIC TRIUMPH.

This was a combination of many things. Long and intense product review sessions. Critical testing of alloys for durability and conductivity. Throwing good prototypes away because they weren't good enough. And in the end, emerging with three removable FM-AM tuner/cassette players worthy of the name Alpine.

The problem wasn't making these units removable. It was making them *sound* absolutely magnificent regardless how many times they had been removed (progressive sound degradation being the most common failing of removable radios).

To this end, Alpine technicians employed in these new units their most reliable tape mechanisms, engineered to maintain precise tape-head alignment despite the typically rough handling removable radios must endure.

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Alpine is standard equipment in the Lamborghini Countach.

What was an idea has become a triumphant reality: three sonically superior removable radio/cassette players that are Alpine-quality down to the last circuit. And built for the long, long haul.

You can now hear the new Alpine Removables, the 7385, 7284 and 7283, at your nearest Alpine specialist. ALPINE

Audio CDs contain six as yet unused subcode bits; the designers guessed that some unspecified space might come in handy.

The indicated time-within-track is set to zero at the beginning of each track (including the lead-in and lead-out areas) and is increased during the track to show elapsed time (Fig. 3). At the beginning of a pause, however, time-within-track is set equal to the length of the pause, and is decreased during the pause until it reaches zero at the end of the pause. Absolute time stays at zero throughout the lead-in, then increases continuously, right to the end of the lead-out. Time-within-track and absolute time are expressed in minutes, seconds, and frames; a frame is equal to 1/75 S.

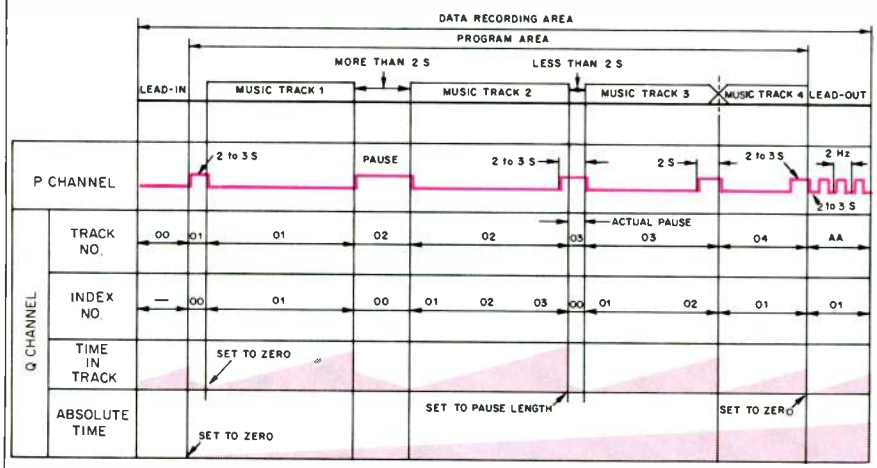

Fig. 3—Relationship of P and Q subcode information to the lead-in, music, and lead-out tracks on an audio CD.

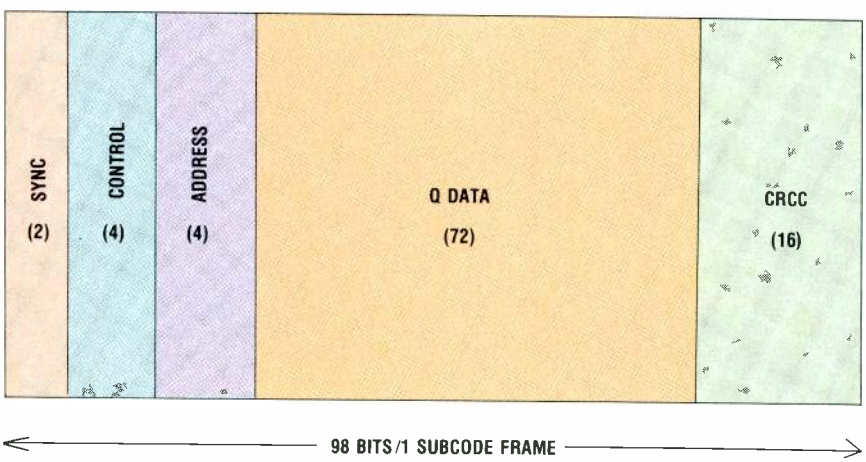

Fig. 4—Data structure of a Q subcode frame. The meaning of the Q data depends on the mode, which is indicated in the "Address" field, and on the frame's location on the disc (see text).

Mode 2 and Mode 3 Q-channel data fields are both optional. Mode 2 contains the catalog number of the disc in 52-bit UPC (Universal Product Code) bar-code form. Mode 3 data, which is present only in the program area, gives the ISRC (International Standard Recording Code) for each music track. The ISRC number gives the country code, the owner code, the year of recording, and a serial number. If Mode 2 or Mode 3 is used, it must appear in at least one out of each 100 subcode blocks.

Every audio Compact Disc contains additional data capacity in the guise of the other six subcode bits (designated R through W). They account for about 20 megabytes of storage and are available for video information. The original disc designers guessed that a little spare room of unspecified space might come in handy some day. On the other hand, they may have goofed, wasting gobs of optical storage capacity forever.

The P and Q subcode bits are important in playing back music, but the R through W bits are recorded with zeros on most audio discs. With the advent of CD-I, the relatively crude R through W subcode may never be extensively commercialized.

The PQ subcode is thus special data, plucked from the bit stream. It gathers control information from the bit stream to inform the player of parameters relevant to decoding.

I hope that with your new insight into the secret dealings of the subcode, you've come to appreciate a CD as more than just a recording. It is an intelligent, self-directed storage system, somewhat like a self-reading, smart book. The player knows how to read, and the subcode tells it when to turn the pages. What is written on the pages is entirely up to the software producer. With that in mind, surely the wide diversity of CD applications becomes apparent.

Next time someone asks, "Oh, is that your CD player?" you should answer, "No, that's my information retrieval system." Because that's a better description of what you've got.

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DELAWARE: Dover Sound Studio **Newark** Sound Studio **Wilmington** Sound Studio

FLORIDA: Boca Raton Verns Electronics **Bradentom** Stereorama **Brandon** Stereorama **Clearwater** Stereorama **Coral Gables** Florida Car Sounds, Sound Advice **Ft. Meyers** Stereo Garage **Ft. Lauderdale** Sound Advice **Ft. Pierce** Sound Shack **Ft. Walton Beach** Professional Auto Radio **Gainsville** Couch Electronics **Hialeah** Walder Electronic **Hollywood** Sound Advice **Jacksonville** Audio Tech, Audio Tech Regency, Discount Sound, Discount Sound Jackson, Hoyt Hi Fi Center **Lake Wales** Carousel Records **Lake Worth** Audio Advisors **Lakeland** Carousel Records **Longwood** Audio Garage **Marathon** Sound Source **Miami** Electronic Consumer Florida Car Sounds, Las Fabricas, Metro Electronics, Olson Electronics, Preston Electronics, Sedoris Electronics, Sound Advice, Sympathetic Ear Walder Electronic **N. Miami** Cartronics **N. Miami Beach** Sound Advice **Naples** Stereo Garage **Newport Richey** Stereo Specialties **Orange Park** Audio Tech **Orlando** Audio Garage **Panama City** Watt Sound Stereo **Pensacola** All Pro Sound **Pinellas Park** Car Stereos Unlimited, Stereorama **Rockledge** Car Radios USA **Sarasota** Stereorama **S. Daytona** The Car Stereo Company **St. Petersburg** All States Radio **Stuart** Fox Audio **Sunrise** Sound Advice **Tallahassee** The Stereo Store **Tampa** Sound Advice, Stereorama Of Tampa **Vero Beach** Audiohouse **W. Palm Beach** Sound Advice **West Melbourne** Street Sound **Winter Haven** Carousel Records **Winter Park** Audio Garage

GEORGIA: Atlanta American Radio, Spectrum Sound, Stereo Designs **Augusta** Stereo City of Georgia **Brunswick** Hi & Hi Service Store **Chamblee** American Radio **Columbus** Audio Connection **Cornelia** Vaughn Music **Dalton** Sound Service **Decatur** American Radio **Dublin** World Hi Fi **Gainsville** Electronic Sales **Jesup** Radio Shack **La Grange** R T R Limited **Lawrenceville** Sound Pro **Lilburn** Sound Pro **Marrietta** American Radio **Milledgeville** World Hi Fi **Rome** World Hi Fi **Roswell** American Radio **Savannah** Radio Center Southland Sound **Thomasville** Hi Fi Sales & Service **Tifton** Bergers Audio & TV **Valdosta** Stereo Connection **Warner Robbins** World Hi Fi Electronics

HAWAII: Aiea Electronic Entertainment **Hilo** Hilo Audio **Honolulu** Auto Audio Electronic Entertainment, Island Sound **Kahului** Electronic Entertainment **Kailua** Car Tunes **Lihue** Auto Systems Kauai **Waiuku** Electronic Entertainment

IDAHO: Boise Sound Pro **Coeur D' Alene** American Television **Idaho Falls** Phase Four Stereo **Lewiston** Stereo Electronics **Moscow** Aspen Sound Inc. **Nampa** Jamison's Music West **Pocatello** Phase Four **Twin Falls** Audio Warehouse

ILLINOIS: Algonquin Team Electronics **Alsip** Car Tronics **Alton** Reliable Stereo & Video **Arlington Heights** Columbia Audio Video **Aurora** Stereo Systems **Belleville** Audio Musicale **Carbondale** Nalder's Stereo **Champaign** Good Vibes Sound **Chicago** Automotive Sound Systems, Capitol Service Mobile Music, United Audio Centers **Danville** Bud's Car Stereo **Decatur** Apple Tree Stereo **Deerfield** United Audio Centers **DeKalb** Appletree Stereo **Downers Grove** Safeland **Elmwood Park** Finishing Touch Car Care **Highland Park** Autosonics, Columbia Audio Video **Jacksonville** Music World 1st In Video **Joliet** Stereo Systems **Kankakee** The Shoppe **Lansing** Unitek Electronics **Moline** Ram Automotive **Mount Prospect** Mobile Music **Mt. Vernon** Dons Stereo & Speed Center **Naperville** Stereo Systems **Niles** United Audio Centers **Normal** Appletree Stereo **Palatine** Auto Sound **Peoria** Team of Peoria **Quincy** Music World 1st In Video **Rockford** Appletree Stereo, Columbia Audio Video **Schaumberg** United Audio Centers **Spring Valley** Audio Labs **Springfield** Sundown One **St. Charles** Autobahn Services **Sterling** Sterling Electronics **Vernon Hills** United Audio Centers **Villa Park** Hi Fi Hutch **Westmonl** Sounds Deluxe

INDIANA: Bloomington Alan Audio **Carmel** Sound Productions **Evansville** Risley Audio **Ft. Wayne** Classic Stereo Pak **Highland** Road Concepts **Indianapolis** Audio Electronics, Ovation Audio Sound Productions **Jasper** Audio World **Madisonville** Risley **Marion** Classic Stereo **Mishawaka** Auto Radio Specialists **Muncie** Classic Stereo **S. Lafayette** Good Vibes Sound **South Bend** Classic Stereo-Pak **Terre Haute** Audio Connection **Vincennes** Record Cellar Audio Video, Risley Electronics

IOWA: Ames Cyclone Motors **Carroll** Sound & Service **Cedar Rapids** Audio Room **Centerville** Wrights Stereo TV & Appliance **Davenport** Audio Odyssey **Des Moines** Audio Lab, Stereo Sound Studio **Dubuque** Audio Room **Ft. Dodge** Sound Unl. **Iowa City** Audio Odyssey Of Iowa **Keokuk** Music World 1st In Video **Mason City** Mason City Sound World **Sioux City** Pflanz Electronics **Spencer** Carey's TV & Stereo **Storm Lake** Sound & Service **Waterloo** Team Electronics

KANSAS: Arkansas City Sparks Music **Dodge City** Cartunes **Emporia** Audio Video Connection **Garden City** Team Electronics **Great Bend** Audio Electronics **Hutchinson** Hayes Sight & Sound **Lawrence** Kief's Record & Stereo **Manhattan** Rolling Thunder **Overland Park** Brands Mart Stereo **Santa Fe** Auto Sound **Topeka** Nelson's **Wichita** Rolling Thunder

KENTUCKY: Bardstown Mr Music **Bowling Green** Poston Electronics **Corbin** Sounds Around Town **Elizabethtown** Replay **Florence** Sight In Sound **Lexington** Ovation Audio, Superb Sound **Lexington** Ovation Audio, Superb Sound Lexington **London** Sounds Around Town **Louisville** Audio Video by Design Music City Sound Factory **Murray** Sunset Blvd. Music **Owensboro** Risley Electronics **Paducah** Risley Electronics **Pikeville** Audio Connection **Prestonsberg** B&W TV Appliance

LOUISIANA: Baton Rouge David's Car Stereo & Comm. **Gretna** Campo Appliance, Stereo Village **Harahan** Mobile One **Lafayette** Rick's Smith Audio, Sound Electronics **Lake Charles** Audio Systems **Mandeville** Campo Appliance **New Iberia** Village Sound Center **Ruston** Music Mart Corp. **Shreveport** Stereo & Record Center **Slidell** Campo Appliance

MAINE: Bangor Radio City **Camden** Harbor Audio & Video **Lewiston** Radio City **S. Portland** Great Northern Sound Co

MARYLAND: Annapolis Spaceways Sound **Baltimore** Carsounds, Discerning Ear, Stansbury Stereo Center **Bethesda** Auto Sound Systems, Radio Electronics Stereo Systems **Frederick** The Electronic Shop **Hagerstown** Hunt Audio & Associates **Langley Park** Audio Associates **Laurel** Audio Associates **Lutherville** Gramaphone **Perry Hill** Stansbury Stereo Center **Rockville** Audio Associates, Audio Sound Systems, Greg's Auto Sound **Salisbury** Sound Studio **Timonium** Carsounds **Waldorf** Car Tec

MASSACHUSETTS: Ashland Creative Car Stereo **Billerica** Mobile Automotive **Boston** Nantucket Sound Tweeter Etc., **Braintree** Nantucket Sound Tweeter, Etc **Brockton** Soundtrack Audio **Burlington** Tweeter Etc **Cambridge** Tweeter, Etc **Chestnut Hill** Tweeter, Etc **Danvers** Rich's Car Tunes, Tweeter, Etc **Dedham** Tweeter, Etc **Fitchburg** Music Forum **Framingham** Natural Sound Tweeter, Etc **Framington** Auto Stereo Place **Gardner** Music Forum **Greenfield** Long Radio, Music Store **Hyannis** Nantucket Sound, Tweeter, Etc **N. Attleboro** Audio Concepts **N. Dartmouth** Riches Auto Radio **Northampton** Classic Audio **Norwood** Northeast Security & Stereo **Peabody** Nantucket Sound **Pittsfield** Taylor of Sound **Saugus** Nantucket Sound, Northeast Security & Stereo **Shrewsbury** Leiser Sound Rayco Car Service **Springfield** Long Radio, Springfield **Stoneham** Auto Sound North **Waltham** Waltham Camera & Stereo **Watertown** Beaconwood Acoustics, Rich's Cartunes

MICHIGAN: Allen Park Car Tunes Stereo Center **Ann Arbor** Hi Fi Buys **Bay City** Olson Auto Radio, Superior Sound **Berkley** Car Tunes Stereo Center **Birmingham** Gramaphone **Dearborn** Radio Frank **Drayton Plains** Dixie Sound **E. Lansing** Hi Fi Buys **Flint** Custom Auto Sound **Grand Rapids** Classic Stereo **Jackson** Jackson Auto Sounds **Kalamazoo** Classic Stereo **Lansing** Hi Fi Buys, Skory Auto Sounds **Marquette** American TV **Midland** Hi Fi Buys **Muskegon** Langlois Stereo **Petoskey** Kurtz Music **Port Huron** The Van Shop **Saginaw** Olson Auto Radio **St. Joseph** Tri County Audio **Traverse City** Kurtz Music **Warren** Radio Frank **Westland** Car Tunes Stereo Center **Ypsilanti** Future Sound & Communication

MINNESOTA: Alexandria Audio Concepts **Baxter** Stereo 1 **Bemidji** Team Electronics **Brooklyn Center** Audio King **Burnsville** Audio King **Duluth** Stereo 1 **Edina** Audio King **Fairmont** Midwest Satellite Audio & Video **Fargo** Stereo 1 **Fergus Falls** Team Electronics **Golden Valley** Audio King Car Stereo Center **Grand Rapids** Team Electronics **Hibbing** Team Electronics **Hopkins** Transportation Electronics **Mankato** Audio King **Maplewood** Audio King Car Stereo Center **Minneapolis** Audio King, **Minnetonka** Audio King **Rochester** Audio King **Roseville** Audio King **St. Louis Park** Audio King Electronics **St. Paul** Audio King **St. Cloud** Stereo 1 **Virginia** Team Electronics **Wilmar** Sound Image **Winona** Amalgamated Audio

MISSISSIPPI: Columbus Audio Advantage **Greenville** Cartunes **Gulfport** Campo Appliance Empress Of Mississippi **Hattiesburg** Hi Fi Cruisin' **Jackson** Automotive Audio **Laurel** Hi Fi Cruisin' **McComb** Custom Audio **Natchez** Sound Circuit **Oxford** Sights & Sounds **Pascagoula** Empress Audio & Video **Toledo** Audio Advantage **Vicksburg** Sound Circuit

MISSOURI: Cape Girardeau Stereo One **Columbia** D&M Sound **Kansas City** Brands Mart Stereo **Kirksville** Wrights Stereo **Knob Noster** Gambles **Lebanon** Sight & Sound **Poplar Bluff** American Hi Fi **Rolla** End Of The Rainbow **Springfield** House of Sound **St. Louis** Hi Fi To Fum, Sound Central **Sunset Hills** Hammond Electronics **West Plains** Hubert's Radio & TV

MONTANA: Billings Sound Pro **Bozeman** Sound Pro **Butte** Ossello's **Great Falls** Rocky Mountain Hi Fi Sound Pro **Havre** Northern Electronics **Helena** Sound Pro **Missoula** Electronic Parts

NEBRASKA: Columbus Columbus Music Co. **Grand Island** Midwest Audio **Lincoln** Stereo West **N. Platte** Team Electronics **Norfolk** Mid City Stereo **Omaha** Custom Electronics Stereo West **York** Midwest Audio

NEVADA: Las Vegas Import Audio **Reno** Car Audio Systems, "Such a Deal" Electronics

NEW HAMPSHIRE: Concord Audio Of New England **Exeter** Auto Sounds Of New Hampshire **Keene** Sound Power **Laconia** Audio Of New England **Manchester** Campus Hi Fi, Tweeter Etc **Nashua** Tweeter Etc **Newington** Tweeter, Etc. **Rochester** Campus Hi Fi, Sam Cuomo's **W. Lebanon** Car Sounds

NEW JERSEY: Belleville Zippos Car Stereo **Cherry Hill** Auto Sound Delaware, Soundworks **Deptford** Hi Fi Connection **E. Brunswick** Atlantic Stereo **Edison** Zippos Car Stereo **Hasbrouck Hts.** Sadsie Bros. Stereo **Howell** Fidelity Car Stereo **Marlton** Hi Fi Connection **Millburn** Professional Audio **Minehill** Linear Electronics **Morristown** Headquarters Sound Express, **N. Plainfield** Audio 22 **Neptune** Audio North **Newton** Partroy Sound **Paramus** Leonard Radio, Video Warehouse-Rabson's **Pleasantville** Fidelity Car Stereo **Ramsey** Rolling Tone **Raritan** AC Audio & Video **Ridgefield** Galaxy Sound **Ridgewood** Motoring Images **Scotch Plains** Kartunes **Shrewsbury** Monmouth Stereo **Tom's River** Sound's Camera & Hi Fi **Trenton** Hal's Stereo Sound Center, Sound Automotive Universal Stereo **Union City** A&D Auto Stereo Sound **Waterford Works** Van House Coach **West Caldwell** Samm Sound **Westwood** Cousin Music

NEW MEXICO: Albuquerque West Coast Sound Systems, Hudson's Audio Center **Carlsbad** Beason's **Clovis** Towne Crier **Farmington** Sound On Wheels **Gallup** Uncle Hiawatti's Cartunes **Las Cruces** The Sound Room **Raton** Odyssey Music **Roswell** Street Sounds **Santa Fe** West Coast Sound Systems, Taos Que Pasa Music & Electronics

NEW YORK: Albany Jo-Di's Sound Center **Allegheny** Sound Track **Amherst** Amherst Electronics **Auburn** Mayco Radio **Batavia** Unicorn Record & Audio **Bay Shore** Papa Angelos, Drive-Ons **Boonville** Adirondack Music **Bronx** Fordham Auto Radio, Professional Auto Radio **Brooklyn** Phils Auto Radio, Stereo Warehouse-Rabson's **Corning** Chemung Electronics **Eastchester** Auto Concepts **Elmira** Chemung Electronics **Freeport** Rogers Stereo **Fresh Meadows** Sound Stage Audio **Garden City** Car Tunes Auto Stereo, Stereo Warehouse-Rabson's **Glenn Falls** Audio Genesis **Greece** Stereo Shop **Hartsdale** S&I Electronics **Henrietta** Stereo Shop **Hicksville** Audio Designs, Designtronics **Huntington Station** Audio Break throughs **Ithaca** Chemung Electronics, Sound Image **Kingston** Auto Sound Systems **Latham** Auto Radio Repair **Manhasset** Audio Breakthroughs **Mt. Kisco** Four Wheel Sound **Mt. Vernon** Central Lock Co. **Nanuet** Short Stop Car Radio **New York** Leonard Radio Sound Stage Audio, Audio Salon **N. Syracuse** GP Enterprises **Oneonta** Stereo Lab **Patchoque** Square Deal **Plattsburgh** Great Northern Stereo Whse. **Port Jefferson** Designatron's Stereo Store **Poughkeepsie** Sound On Wheels **Riverhead** Showtime Stereo **Rochester** Stereo Shop **Rosedale** S F Sound Unlimited **Salamanca** Sound Track **Saratoga Springs** Le Sounde **Schenectady** Apollo Sales **St. James** Konstant Audio **Staten Island** Clone Audio **Syossett** American Soundcraft **Syracuse** GP Enterprises, Gordon Electronics **Valley Stream** Stereo Warehouse-Rabson's **Vestal** Gordon Electronics **Wappinger Falls** Sound Odyssey **Watertown** Northern Electronics **White Plains** Audio Experts Westchester Stereo **Whitesboro** Adirondack Music **Williamsville** Stereo Advantage **Woodside** Leonard Radio

NORTH CAROLINA: Asheville Mr Toads **Chapel Hill** Stereo Sound **Charlotte** Carolina Car Stereo Sound Systems **Concord** Carolina Car Stereo **Conover** Audiohaus **Durham** Dashboard Stereo, Vickers Audio **Fayetteville** Sound Systems **Goldsboro** Pro Sound **Greensboro** Audio Video Concepts Sound Systems, Stereo Sound **Goldsboro** Fro Sound Company **Greenville** Todd's Stereo Center **High Point** Audio Video Concepts **Jacksonville** Onslow Audio Center **Kinston** Stereo Concepts **Morehead City** Anderson Audio **Morganton** Macs TV **New Bern** Anderson Audio **Raleigh** Audio Express **Roanoke** Today's Electronics **Roanoke Rapids** Today's Electronics **Rocky Mount** Microwave World **Wilmington** Atlantic Audio **Wilson** Modern Stereo **Winston Salem** Stereo Sound, Audio Video Concepts, Custom Car Hi Fi

NORTH DAKOTA: Bismark Pacific Sound **Dickson** Music Hut **Grand Forks** Team Electronics **Jamestown** Music Corner **Langdon** Easy Way **Minot** The Stereo Shop **Williston** Team Electronics

OHIO: Akron Audio Craft, Golden Gramaphone **Cincinnati** Sight In Sound **Cleveland** Audio Craft, B&B Appliance **Columbus** Hammond Electronics **Dayton** Stereo On Wheels **Elyria** West Com Audio **Findlay** Audio Craft, Soundtrek **Gallipolis** Bob's Electronic **Heath** Hammond Electronics **Lima** Classic Stereo **Mansfield** Hammond Electronics **Mayfield Hts.** Audio Craft **Mentor** West Com Audio **Middleburg Heights** B&B Appliance **Milford** Sight In Sound **Minster** Gudorf & Son **N. Canton** Hammond Electronics **Parma** West Com Audio **Toledo** Audio Craft, Car Stereo One **Westlake** Audio Craft

OKLAHOMA: Bartlesville The Sound Station **Durant** Rick Mackey Sound Center **Enid** Sounds Incredible **Guymon** Sound Service **Lawton** Audio Tech **Moore** Sound World **Oklahoma City** David's Stereo & CB, **Ponca City** Sounds Incredible **Shawnee** Audio Express, Rave Sound **Stillwater** Custom Car Stereo **Tulsa** Imperial Sound, The Phonograph, Ltd. **Weatherford** Phil's Stereo Warehouse **Woodward** Gills Store

OREGON: Beaverton Chelsea Audio **Bend** The Stereo Plant **Corvallis** Good Guys Stereo **Eugene** Good Guys Stereo, Stereo Loft **Grants Pass** Sheckells Stereo **Klamath Falls** The Sound Chamber **Medford** Sheckells Stereo **Portland** Chelsea Audio **Salem** Focus Electronics

The Dalles Lutz Enterprises

PENNSYLVANIA Allentown Sassafras Audio **Altoona** Sound Concepts **Bloomsberg** Webber's Pro Audio **Bryn Mawr** Sassafras Audio **Camp Hill** The Stereo Post **Chambersburg** Sunrise Electronics **Connellsville** The Electronic Tree **Ephrata** Stereo Barn **Erie** PJ s Auto Sound **Feasterville** Sassafras Audio **Gibsonia** Listening Post **Greensburg** Pat's Stereo **Harrisburg** The Stereo Post **Hazelton** Janken Systems **Indiana** Sound Concepts **Jenkintown** Sassafras Audio **Johnstown** Gary's Entertainment Store **Kingston** Summit Audio **Lancaster** GNT Stereo, The Stereo Post, Trojan Yacht **Lebanon** The Stereo Post **Lewisburg** M&M Stereo Equipment **Monroeville** Auto Communications, Listening Post **Montgomeryville** Sassafras Audio **Natrona Hts.** Sound Shack **Philadelphia** Sassafras Audio, Tepper Auto Sound **Pittsburgh** Listening Post **Pottstown** Audio Video Junction **Reiffton** GNT Stereo **State College** High Fidelity House **Upper Darby** Tepper Auto Radio **Washington** The Stereo Outlet **Williamsport** Audio Services **York** Town Sound & Custom Tops

RHODE ISLAND: Cumberland Sounds Unlimited **E. Providence** Tweeter Etc **Providence** Tweeter Etc **Warwick** Island Sound, Tweeter Etc **Westerly** Leiser Sound

SOUTH CAROLINA: Anderson Music Machine **Charleston** Dash board Stereo **Columbia** Music Machine, Rogers Stereo **Greenville** Music Machine **Hilton Head** South land Sound **Rockhill** Tart's **Sumter** Ok Tire Stores

SOUTH DAKOTA: Aberdeen World Electronics **Rapid City** Team Electronics **Sioux Falls** Audio King

TENNESSEE: Chattanooga The Radio Clinic **Cookeville** Network Entertainment **Jackson** Save A Lot Auto **Johnson City** Mr Toads **Kingsport** Mr Toads **Knoxville** Cartunes, Lindsay-Ward **McMinnville** Network Entertainment **Memphis** New Car Stereo, Save A Lot Auto **Murfreesboro** Audiomasters **Nashville** Karco Auto Audio, Network Entertainment Nicholson's Stereo, The Car Stereo Shop

TEXAS: Abilene Bunkley's Sound System **Addison** Earmark **Amarillo** Soundroom of So. Western Music **Arlington** Hawk Electronics, Sound Idea **Austin** Audio Video, Road Sounds **Bay City** Car Stereo Center **Beaumont** Brock Audio **Brownsville** El Arca Electronics, Panorama Electronics **Bryan** Road Sounds **College Station** Audio Video **Corpus Christi** Tape Town Audio **Dallas** The Car Stereo Store, Hawk Electronics **Del Rio** Western Auto **Eagle Pass** Trevino Music **El Paso** Casa Sonido, Music Systems, Sound Room Electronics **Fort Worth** Hawk Electronics, Sound Idea **Galveston** Car Stereo Center **Graham** Layfield Music **Houston** Auto Entertainment, Custom Car Stereo, Fingers Furniture Home Entertainment, Sheffield Audio **Humble** Fingers Furniture **Hurst** Sound Idea **Lake Jackson** Car Stereo Center **Laredo** Audio Systems, Ramirez Tire Center **Longview** Stereo & Record Center **Lubbock** Hi Fidelity of Lubbock **Marshall** Stereo & Record Center **McAllen** El Centro Sound Center Showery Stereo, Sound Centers of the Valley **Midland** Electronics Service Center **Nacogdoches** Spinet Music **Odessa** Electronics Service Center **Pampa** Hall's **Pasadena** Coopers Custom Audio Dr. Fingers Furniture **Richardson** Earmark **San Angelo** Sound Box **San Antonio** Bjorn's Stereo Design, Classic Car Audio, Mobile Hi Fi, **San Marcos** Discovery Audio Video **Sherman** The Audio House **Temple** Road Sounds **Texarkana** Texarkana Audio Center **Tyler** Stereo & Record Center **Victoria** Parris Electronics **Waco** Jacks Stereo **Wichita Falls** Audio Sound Systems

UTAH: Logan Lynn's TV & Stereo **Murray** Car Concepts **Ogden** Hi Fi Shop **Provo** Boyers Automotive Center **Salt Lake City** Broadway Music, Standard Audio & Hi Fi **St. George** Arrow Audio **Vernal** The Dirk Lambrum Company

VERMONT: Rutland Sound Directions **S. Burlington** Great Northern Stereo

VIRGINIA: Arlington Audio Associates **Blacksburg** Scotty's Radio & TV **Bristol** Mr Toads **Charlottesville** Auto Sound of Virginia, Stereo Types **Collinsville** Holdrens **Colonial Heights** Auto Sound of Virginia **Danville** Sounds Unlimited **Fairfax** Audio Associates **Falls Church** Car Stereo Systems **Fredericksburg** Contemporary Sounds **Harrisonburg** Ace Music 'n Electronic **Lynchburg** Dons Car Stereo **Manassas** Automotive Hi Fi **Newport News** Go Ho Auto Audio **Pulaski** Scotty's Radio & TV **Radford** Scotty's Radio & TV **Richmond** Auto Sound of Virginia, Lindsay-Ward **Roanoke** Holdren's, Scotty's Radio & TV **Springfield** Audio Associates, Greg's Auto Sound **Vienna** Greg's Auto Sound **Virginia Beach** Audio Connection, Go Ho Auto Audio, Videorama Auto Audio **Winchester** Sound City

WASHINGTON: Bellevue Magnolia Hi Fi, Northwest Audio Video **Bellingham** Sound Advice **Bremerton** Evergreen Audio **Everett** Sound Advice **Federal Way** Sound Advice **Kenmore** Lake City Broadway Northwest Auto Sound **Longview** Sound Authority **Lynnwood** Magnolia Hi Fi, Northwest Audio Video **Moses Lake** Performance Auto Sound **Olympia** Desco Electronics **Seattle** Cartronics, Magnolia Mobile Electronics, Northwest Auto Sound **Spokane** Discover Audio **Tacoma** Automotive Sound, Magnolia Hi Fi **Tukwila** Magnolia Hi Fi, Northwest Audio Video **Wenatchee** Performance Auto Sound

WEST VIRGINIA: Barboursville Pied Piper **Huntington** Pied Piper **Morgantown** Sound Investment **Mt. Gay** Stereo Video Unlimited **Mt. Hope** Pied Piper **Wheeling** Windmill Electronics

WISCONSIN: Appleton Sound World **Eau Claire** EME Audio Systems, **Fond Du Lac** Wisconsin Electronics Exclusive Company Of Wisconsin **Green Bay** Sound World, Muntz Audio/Video **La Crosse** Sound World **Madison** American TV **Milwaukee** General Electronics **Neena** American TV **Oak Creek** American TV & Appliance **Oshkosh** Exclusive Company **Pewaukee** American TV **Racine** Al's Auto Stereo **Sheboygan** Gene's Sound & Camera **Thiensville** D & D Sales **Wausau** Sound World **West Bend** Exclusive Company **Wisconsin Rapids** Wisconsin Electronics

WYOMING: Cheyenne Electronics Unlimited **Gillette** Murphy Sight & Sound, Sound Pro **Laramie** New Music Box **Riverton** Sound Room **Rock Springs** Fanelli Music

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They may appear to be conventional loudspeakers, but your ears will tell you that the new ESB reproducers are something completely new...and superior. Even the best of conventional loudspeakers inevitably distort spatial perspectives; the reproduced sound stage is cramped, skewed, two-dimensional, or grossly exaggerated. ESB, using proprietary phase/dispersion driver control techniques, is able to recreate in time and space the sound of the original musical event. ESB's Distributed Spectrum Radiation technology recreates the original musical sound stage.

Do-It-Yourself Listening Experiment

We suggest a simple, convincing two-step experiment of ESB's Distributed Spectrum Radiation technology.

Experiment 1. Listen to a pair of ESBs from a normal centered listening position while playing a good recording of a voice accompanied by acoustic instruments. Volume should be adjusted for a natural, live-performance level. The voice will be precisely localized in acoustic space. You will hear its vertical and lateral position, and its depth. The locations of the instruments to the right, left, and behind the vocalist will be similarly easy to pinpoint.

Experiment 2. Leave your seat and walk towards the right or left side of the room. The musical image will maintain its perspective, as it would at the live event. You'll find that you can listen from virtually anywhere in the room without alteration of the original acoustic sound stage. (A few "sound-all-around" systems permit off-center listening, but at the expense of precise image localization. Speakers designed for localization from a fixed central listening position inevitably suffer sound-stage collapse into the right or left speaker when you move off center.)

Overall Sonic Quality

We appreciate that recreating the original musical event involves more than stable and accurate stereo imaging. So does J. Gordon Holt, editor of America's first audiophile publication – *Stereophile* Magazine, who wrote:

"The first thing I noticed about the ESB 7/06 was its tonal accuracy. My God, does this thing have correct tonality!"

"I don't believe I have heard any system that reproduces instrumental timbres so truly."

"Overall balance is superb."

"The extreme high end is remarkably open and detailed."

"The system's low end is, or can be if the music so demands, positively awesome! Big, deep and solid, with equally good rendition of impact and continuous bass."

"...the ESB 7/06 is immensely exciting to listen to. One reason for this is its remarkable dynamic range. From the way the orchestra opens up and projects when all the instruments cut loose, it sounds as if it had a built-in volume expander!"

"Imaging is quite specific, very stable, and as mentioned previously, stays put across a wide listening area."

The ESB 7/06 systems reviewed by Mr. Holt are $1800 each. But the same Distributed Spectrum Radiation technology responsible for its superb performance is also available in the $350 ESB 7/10. In fact, there are six different ESB models scaled to suit your musical requirements and budget.

For a set of all three color wall posters, send a check or money order for $15. to: Mondial Designs Ltd., 2 Elm Street, Ardsley, New York 10502 (914) 693-8008

We invite you to perform ESB's spatial definition experiment at the following select audio dealers. We are convinced that once you hear the original musical event recreated by ESB, you will be satisfied with nothing less.

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San Francisco, Stereo Store
Foster City, Digital Sonics
Westminster, Audio Today
Irvine, SoundQuest
Georgia
Savannah, Audio Warehouse
Michigan
Ann Arbor, Sound Associates
DeWitt, jemstone
Flint, Stereo Center
New Jersey
Cliffside Park,
Entertainment Environments
Montclair, CSA
Paramus, Leonard Radio
New York
Manhattan, Leonard Radio
Queens, Leonard Radio
Pleasantville, Audio Excellence
Newburgh, Randzins
Wappingers Falls, Randzins
North Carolina
Charlotte, Higher Fidelity
Pennsylvania
Philadelphia, Sassafras
Montgomeryville, Sassafras
Jenkintown, Sassafras
Bryn Mawr, Sassafras
South Carolina
Charleston, Audio Warehouse
Texas
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Virginia
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Washington
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IVAN BERGER

TROUBLE OR NOTHING

R-DAT and Copy-Guarding

The prospect of R-DAT home recorders that can make perfect digital copies makes record-company executives perfectly sick. They fear that DAT's recording quality will not only encourage home taping of commercial recordings but will also encourage professional record pirating. And the very last thing they want is a system that could make digital-to-digital copies from CDs—that would be like putting a "Take Me" sign on a studio master tape.

Last year, a bill was introduced into the Senate by John Danforth (R-Mo.) which would have placed a prohibitive 35% duty on DAT machines that were capable of copying CDs, while imposing only a 4.1% tariff on machines with chips which would prevent such copying. (Such an anti-copy system has been developed by CBS and endorsed by the Recording Industry Association of America.) The bill did not pass, but the issue was scheduled to come up again when Congress reconvened in January. The European Economic Community has already informed Japan that DAT machines may be excluded from the Common Market if they are not rendered incapable of copying copyright material.

Meanwhile, Chris Byrne of Akai America told an industry meeting that the public would never accept a copy-guard system that prevented making digital-analog-digital copies. He did suggest that a system to prevent digital-to-digital copying be added to CD software and DAT recorders. Byrne predicted that DAT would sell mainly as an ultra-portable playback system.

In December of last year, top Japanese electronics executives representing the EIAJ (Electronic Industries Association of Japan) met with the International Federation of Phonogram and Videogram Producers (IFPI) to discuss the problem. European and American record companies and European electronics manufacturers supported the IFPI's position that DAT should not be allowed into the U.S. or Europe without a built-in copy-prevention system. The Japanese representatives, however, declared that the EIAJ had no intention of incorporating such a system, which would infringe on consumers' rights.

Even the rudimentary precaution of not allowing DAT machines to record at a CD-compatible sampling rate of 44.1 kHz may not last. In addition to the Sony professional R-DAT deck reported on by Bert Whyte in his column last month, several Japanese companies reportedly showed CD-compatible R-DAT recorders at last fall's Japan Electronics Show.

Conceivably, R-DAT could wind up as a system of unrestricted versatility—but with its marketing restricted to the Far East.

News and Notes

- It may soon be possible to buy Japanese-made CD players with Kodak optics made in the U.S. Kodak's first such product, a single aspheric lens designed to replace the three-element lenses now in use, became available to player manufacturers last October. More optical products for CD will become available this year.
- Despite all the excitement generated by the Compact Disc, only 6.4% of U.S. families owning stereo equipment had CD players by mid-1986, according to a poll conducted last year by *Newsweek* magazine. Nevertheless, that's more than 3.5 times as many as in 1985, when the figure was only 1.8%. Among audiophiles, of course, CD has made greater inroads—in 1985, for instance, 44% of *Audio*'s readers owned CD players.
- In Boston, engaged couples can register their preferences not only in china, silverware, and linens, but in Compact Discs as well. A local store, Boston Compact Disc, maintains the registry.
- The speed of sound, which was determined in 1942 to be 741.5 mph, has now been recalculated and found to be 0.4 mph slower. The acoustical rule-of-thumb figure of 1 foot per millisecond is therefore more accurate than ever: Sound actually travels 1.087 feet/mS, almost 0.04 inch per second slower than was previously believed.
- Australia's first CD plant, the first in the Southern Hemisphere, is scheduled to open this month. The Disctronics Ltd. plant should be producing more than 7 million discs a year by the end of 1987. At least three other companies have announced plans to produce CDs in Australia as well.
- The latest use of ceramics in audio is for making cassette shells, now available from Sony in Japan. Presumably, the ceramic shells will be immune to heat-induced warping.
- The silvery CD is now available in gold from Mobile Fidelity, for under $30. The company claims that the usual aluminum coating oxidizes and that gold's greater reflectivity reduces dropouts by 90%.

Jolly Good Fellows

Last November, at the 81st convention of the Audio Engineering Society, Richard C. Heyser became the Society's President-Elect. Mr. Heyser, a Senior Editor of *Audio*, is best known in the field for his development of Time Delay Spectrometry, now used in speaker testing and acoustical analysis in many countries. He has been engaged in research with the Jet Propulsion Laboratory in Pasadena, Cal., since 1956 and is a member of the Institute of Electrical and Electronic Engineers (IEEE) as well as a Fellow of the AES.

At the convention, *Audio* Associate Editor B. V. Pisha was named a Fellow of the Society. The honor was awarded in recognition of his "contributions to audio component testing and evaluation." He has been interested and involved in audio for 60 years, and engaged in audio testing since 1953. He first wrote for this magazine in the early 1950s, becoming a Contributing Editor in 1973 and being named Associate Editor in 1984.

This brings the number of AES Fellows on our masthead to five. In addition to Heyser and Pisha, Associate Editors Bert Whyte and Edward Tatnall Canby and Contributing Editor John M. Eargle are Fellows. *Audio*'s founder, the late C. G. McProud, was also a Fellow of the Society.

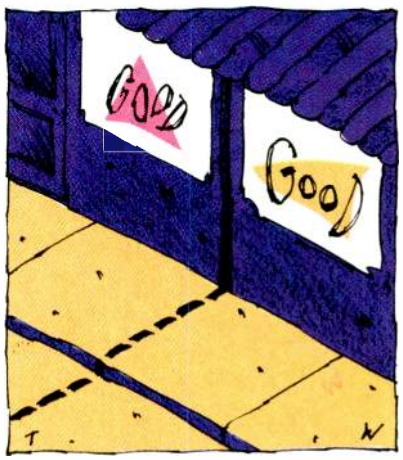


Illustration: Thomas H. Waters

How Good Is "Good"?

I say the Model X cartridge sounds "superior." You say the Model Y sounds "excellent." And Charlie, over there, thinks that the Model Z sounds "ideal."

Peter, who's heard none of these cartridges, wonders which of the three sounds best. He'll have a devil of a job figuring it out, according to a recent paper in the *SMPTE Journal*, published by the Society of Motion Picture and Television Engineers.

In "Graphic Scaling of Qualitative Terms" in the November 1986 issue of the *Journal*, Bronwen L. Jones and Pamela R. McManus of the CBS Technology Center reported on an international experiment in which test subjects were asked to show in what order they ranked subjective rating terms like the ones mentioned above. They were also asked to show how far apart they placed these terms on a linear scale.

The article shows that the difference between subjective rating terms depends on where the raters come from and how the rating words are presented. For example, test subjects in the Eastern U.S. considered "ideal" and "superior" to be just about the same, and better than "excellent." But subjects in the West and in Cleveland considered "excellent" to fall between the other two ratings, with "ideal" best and "superior" worst of the three. Subjects in Pittsburgh, however, considered "excellent" the highest praise.

For the U.S. as a whole, "superior" came out on top, with the other two ratings tied for second place. In Italy, on the other hand, "eccelente" ranked highest, followed by "superlative" (at the same graph level as "superior" here). "Ideale" ranked far behind our "ideal" and "excellent."

Furthermore, it makes a difference whether subjects are given a list of words and asked to rank them all or are presented with words one by one. Changing the way in which the words are presented doesn't change the order of their rankings, but does change the distance that raters put between them.

So which of the three cartridges should Peter buy? Naturally I'd recommend the Model X; it was the one I called "superior," and to us Easterners that's about as good as things can get. In practice, though, Peter should pay more attention to such factors as how each will work with his tonearm, and what each costs, than to his friends' opinions. All three terms connote very similar levels of quality, well above what any of us would call merely "good" or "fine."

CD Goes to New Lengths

A Swedish record company, BIS, tried to bring out a two-hour CD last year according to *Which Compact Disc?*, a British publication. To get around CD's playing-time limit of just under 75 minutes, BIS recorded one-hour-long monophonic programs in each channel. Polygram, however, refused to master and press the BIS recording because it failed to conform to the CD standards. At last report, BIS was still looking for a pressing plant for the disc.

Island Records and Jive Records had better luck. They produced the first CD "singles," selling for £5.75 (about $8.25) apiece, about twice what 12-inch phono singles sell for in Britain. Island's "Angeline," by John Martyn, held five tracks and played for 25 minutes; Jive's Ruby Turner disc, "If You're Ready (Come Go with Me)," played for 15 minutes. The discs were the standard 12-cm diameter. While CD players' tracking systems (which start at the center of the disc and stop when they reach the outer rim) could cope with smaller diameter recordings, few players' loading systems could do the same.

Meanwhile, sales of 45-rpm singles are dropping rapidly. According to a story in *The New York Times*, singles are surviving mainly for jukeboxes (whose numbers are shrinking) and for promotion of specific songs. With the coming of CD jukeboxes and, perhaps, greater numbers of CD singles, these reasons for the 45's survival may disappear. The 45's immediate replacement, however, may be the "cassingle"—a short recording on cassette tape.

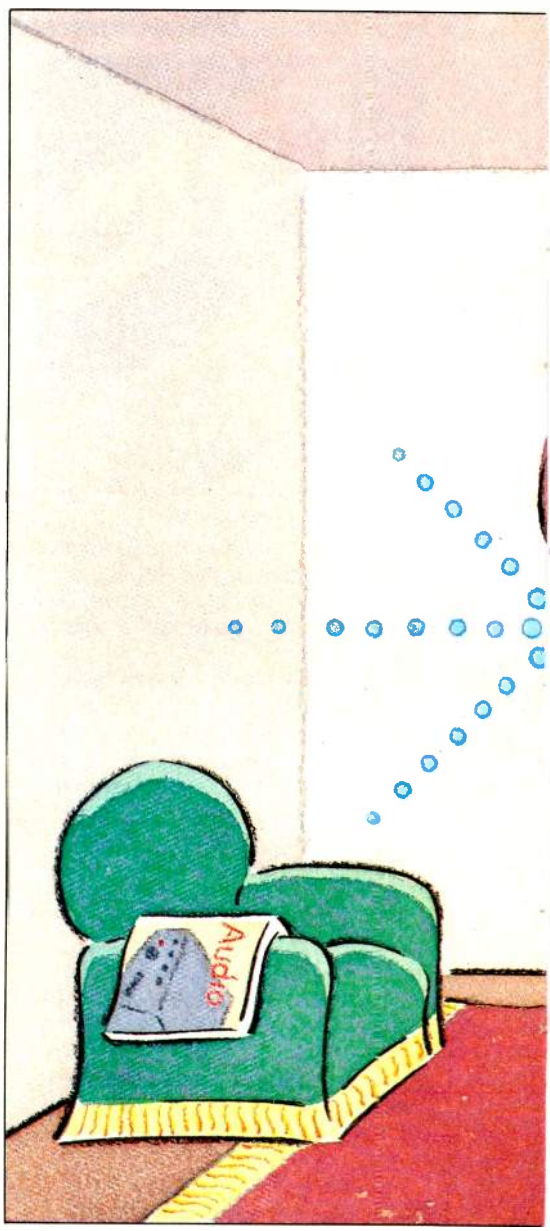
Illusions For Stereo Headphones

DR. DIANA DEUTSCH

Early on around this magazine, there was a sort of Occam's Audio Razor: "If a piece of gear measures well but sounds bad, it is bad, but if it sounds good and measures poorly, it's a good piece of gear." The idea behind the quasi-motto was to free one's ears, and perception, from the tyranny of meters. Over the last four decades, lots of midnight oil has been burned trying to make measurements mean something, which usually wound up as an attempt to make gear which already sounded good also measure well. On the hi-fi end of things, at least, not much effort has been spent on what it means to "sound good," or "hear well," or simply "hear."

How we hear is an endlessly fascinating subject for some few audiophiles, most of whom know how easily any of the senses—and hearing is no exception—can be fooled. Indeed, stereo sound *is* an illusion. If, however, you have ever listened to a discussion of how one hears at a hi-fi store, audio club or even a learned society convention, you have already found out how few people are truly knowledgeable in this area.

In an effort to free us from the tyranny that the ear is an infallible judge of sound, I am proud and pleased to present an article, with an illustrative Eva-Tone SoundSheet, by one of the few true authorities in this field, Dr. Diana Deutsch, on what a curious thing it is, our sense of hearing.—*E.P.*



In increasingly large numbers, people are choosing to listen to music through stereo headphones. This development has occurred despite the fact that most recordings are not designed for headphone listening, but rather to be played through loudspeakers. It is a happy coincidence that stereo recordings sound acceptable either way. Yet the creative opportunities provided by headphone listening have only just begun to be explored.

One highly successful use of headphones involves binaural recording. Two microphones are placed at the ears of a dummy, and two very similar recordings are produced from these, differing only as would the sound signals arriving at the ears of a listener situated in the same position. When these recordings are played back through stereo headphones, remarkable realism is obtained.

There is, however, another use of stereo headphones which takes us in the direction opposite that of increased realism, to an unexpected and paradoxical world of illusion. Rather than presenting highly similar signals to the two ears, entirely different signals are

presented. Effects obtained with this technique are not only startling to experience, but also demonstrate certain properties of the hearing mechanism which might otherwise have passed unrecognized.

Let us begin with a very simple sound pattern, which is illustrated in Fig. 1. A 400-Hz sine-wave tone is delivered to one ear, and at the same time an 800-Hz sine-wave tone is delivered at equal amplitude to the other ear. When this combination lasts for

Dr. Diana Deutsch has been a member of the research faculty of the University of California, San Diego, since 1970, the year she was awarded a Ph.D in psychology from that institution. She is the founding editor of Music Perception, *a journal published by the University of California Press; coauthor (with J. A. Deutsch) of* Physiological Psychology *(Dorsey Press, 1966; Second Edition, 1973), and editor of* The Psychology of Music *(Academic Press, 1982). In addition, she is an active member of the Acoustical Society of America and has served on the Advisory Council of the International Association for the Study of Attention and Performance. She is a Fellow of the American Association for the Advancement of Science and of the Society of Experimental Psychologists. Recently made a Fellow of the Audio Engineering Society, she was guest editor for a special issue, entitled "Auditory Illusions and Audio," of the Society's journal (Vol. 31, No. 9, Sept. 1983).*

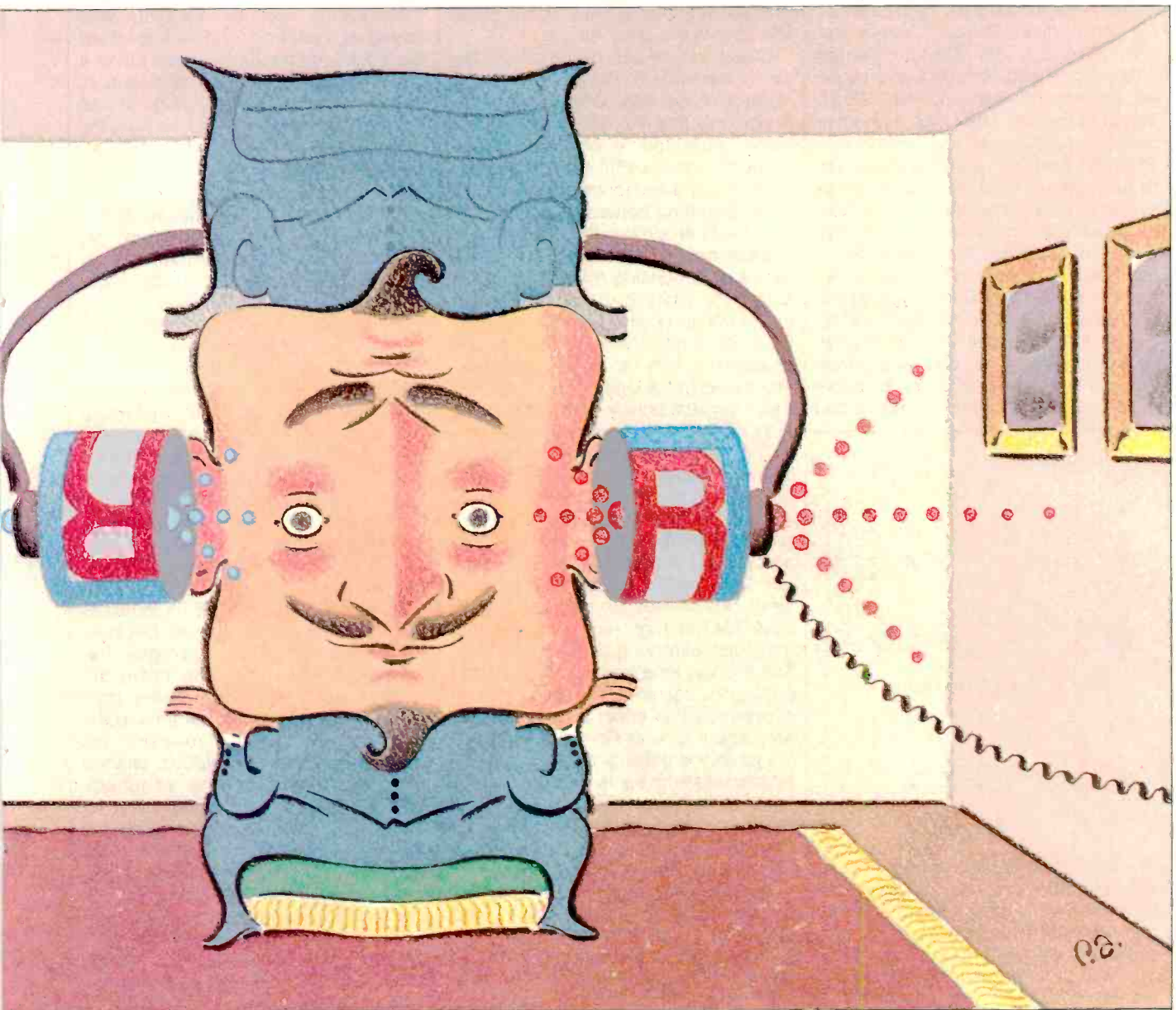


Illustration: Philip Anderson

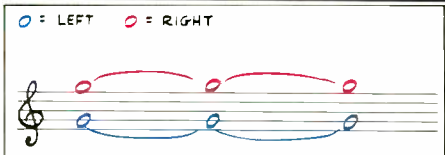


Fig. 1—400-Hz sine-wave tone delivered to left ear and 800-Hz tone to right ear.

several seconds, most people hear both the high tone and the low one, and can localize them correctly.

Now let us consider a variant of this pattern which I devised. (See Deutsch, D., "An Auditory Illusion," *Nature*, Vol. 251, 1974, pgs. 307-309.) For the first 250 mS, the 800-Hz signal is presented to the right ear and the 400-Hz signal to the left. The tones then interchange positions, so that for the next 250 mS the 400-Hz signal is presented to the right ear and the 800-Hz signal to the left. The tones then switch back to their original positions, and the procedure is repeated. So, as illustrated in Fig. 2A, each ear receives a pattern that consists of two tones presented in alternation. Yet when the right ear receives the high tone, the left ear receives the low tone, and vice versa. This pattern is given in Sound Example 1. (Be sure, when listening to this and

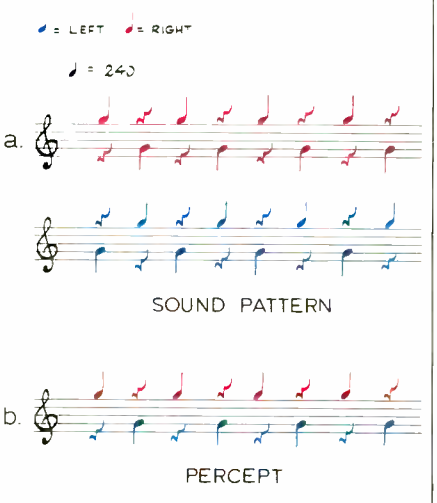


Fig. 2—Octave illusion pattern, with 400- and 800-Hz tones first delivered to left and right ears, respectively, and then interchanging positions every 250 mS (A); and the most common percept resulting from that pattern (B).

the other examples, that the loudspeakers on your system are turned off, and that the channels are carefully balanced for loudness.)

Surprisingly, this simple pattern is almost never heard correctly, and instead gives rise to a number of illusions. Most people obtain a percept such as illustrated in Fig. 2B. This consists of a single tone which switches from ear to ear; as it switches, its pitch simultaneously shifts back and forth between high and low. In other words, the listener hears a single high tone in one ear which alternates with a single low tone in the other ear.

Clearly, there can be no simple basis for this illusion. We can explain the perception of alternating pitches by supposing that the listener hears the tones presented to one ear and ignores the others. But then we cannot explain why these tones should appear to be switching between ears. Alternatively, we can explain the perception of a single tone which alternates from ear to ear by supposing that the listener is constantly shifting his attention between left and right. But then the pitches of the tones shouldn't change with changes in their perceived locations. The illusion of a single tone that alternates simultaneously *both* in pitch *and* in location presents us with a paradox.

The effect becomes even stranger when we consider what happens when the earphone positions are reversed. The ear that had been hearing the high tone continues to hear the high tone, and the ear that had been hearing the low tone continues to hear the low tone! This creates the peculiar impression that the high tone has migrated from one earphone to the other, and that the low tone has also migrated in analogous fashion. The best way to experience this effect is to switch the earphones around several times while the pattern is playing, and ask yourself each time which ear is hearing the high tone. Most people find that the high tone appears to stay in one ear and the low tone in the other ear, regardless of how the earphones are positioned.

Another interesting thing to try at this point is to begin by listening to the illusion in stereo, and then change the setting to mono, so that both ears now receive both channels. At this point your percept should change dramatically: You should hear a single complex tone coming simultaneously from both earphones, together with clicks occurring four times per second. (The clicks are due to the transients produced by switching the signals between 400 and 800 Hz). Then change the setting back to stereo, and the illusion should reappear. Sound Example 2 presents the pattern in stereo, then in mono, and then in stereo again.

How can we account for this illusion? Clearly, there is no simple explanation. But if we assume that separate brain mechanisms exist for deciding *what* sound we hear and for deciding *where* the sound is coming from, we are in a position to advance an explanation. The model is illustrated in Figs. 3 and 4. To obtain the perceived pitches, the frequencies arriving at one ear are attended to, and those arriving at the other ear are suppressed. However, each tone is localized at the ear receiving the higher frequency signal, regardless of whether a pitch corresponding to the higher or the lower frequency is in fact perceived.

Figure 3 illustrates the model for the case of a listener who perceives the pitches corresponding to the frequencies delivered to his right ear. When a high tone is delivered to his right and a low tone to his left, he hears a high tone, because this is delivered to his right ear. He also localizes the tone in his right ear, because this ear is receiving the higher frequency. But when a low tone is delivered to the right ear and a high tone to the left, he now hears a low tone, because this is delivered to his right ear, but he localizes the tone in his left ear instead, because the left ear is receiving the higher frequency. So he hears the entire sequence as a high tone to the right which alternates with a low tone to the left. You can see that reversing the earphone positions wouldn't change this basic percept (the sequence would simply appear to be offset by one tone). However, Fig. 4 illustrates the same model for the listener who perceives the pitches corresponding to the frequencies delivered to his left ear instead, using the same localization rule. You can see that the identical pattern is now heard instead as a high tone to the left alternating with a low tone to the right.

Right-handers and left-handers differ statistically in terms of where high and low tones appear to be localized.

In order to test this hypothesis, I devised a new pattern, illustrated in Figs. 5 and 6. You can see that one ear receives three high tones followed by two low tones, while simultaneously the other ear receives three low tones followed by two high tones. This basic pattern is repeatedly presented, without pause. It was found that, indeed, most people perceived a pattern of pitches corresponding to the frequencies presented either to the right or to the left. That is, they heard a repeating pattern that consisted either of three high tones followed by two low tones, or of three low tones followed by two high tones. Also in confirmation of the model, each tone was localized in the ear receiving the higher frequency, regardless of whether a pitch corresponding to the higher or lower frequency was in fact perceived.

So when a low tone was heard, it appeared to be coming not from the earphone which was in fact delivering it, but from the opposite earphone. When a listener who heard the pitches delivered to his right ear was presented with channel A to his right and channel B to his left, as shown in Fig. 5, he heard three high tones to his right alternating with two low tones to his left. When the earphone positions were reversed, as shown in Fig. 6, this listener now heard *two* high tones to his right alternating with *three* low tones to his left! So the procedure of reversing the earphone positions appeared to cause the channel to the right to mysteriously drop a high tone and the channel to the left to mysteriously add a low tone! (See Deutsch, D. and P. L. Roll, "Separate 'What' and 'Where' Decision Mechanisms in Processing a Dichotic Tonal Sequence," *Journal of Experimental Psychology: Human Perception and Performance*, Vol. 2, 1976, pgs. 23-29.)

There is yet another surprising aspect to this illusion: Right-handers and left-handers differ statistically in terms of where the high and the low tones appear to be localized. In one study, I had people listen to this pattern with earphones positioned first one way and then the other. Most right-handers heard the high tone on the right and the low tone on the left, with earphones placed both ways. But left-handers didn't show this tendency.

In a more extensive study, I divided the population of listeners into three groups on the basis of handedness, using the Varney and Benton handedness questionnaire shown in Fig. 7. People scoring at least nine out of 10 "rights" were designated right-handers, those scoring at least nine out of 10 "lefts" were designated left-handers, and those with eight or fewer "lefts" or "rights" were designated mixed-handers. Each group was then further divided into two on the basis of whether or not the listener had a left- or mixed-handed parent or sibling.

This six-way division was found to correlate with how the octave illusion was perceived. Right-handers were more likely to hear the high tone on the right than were mixed-handers, and mixed-handers were more likely to do so than were left-handers. And for all three handedness groups, those without left- or mixed-handed parents or siblings were more likely to hear the high tone on the right than were those with left- or mixed-handed parents or siblings. (See Deutsch, D., "The Octave Illusion in Relation to Handedness and Familial Handedness Back-

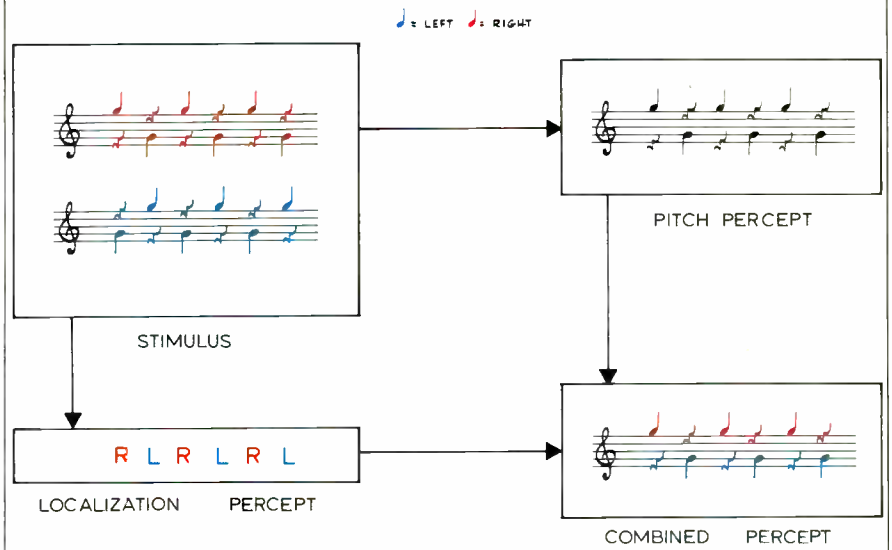


Fig. 3—Perceived pitch and localization for "right-eared" listener.

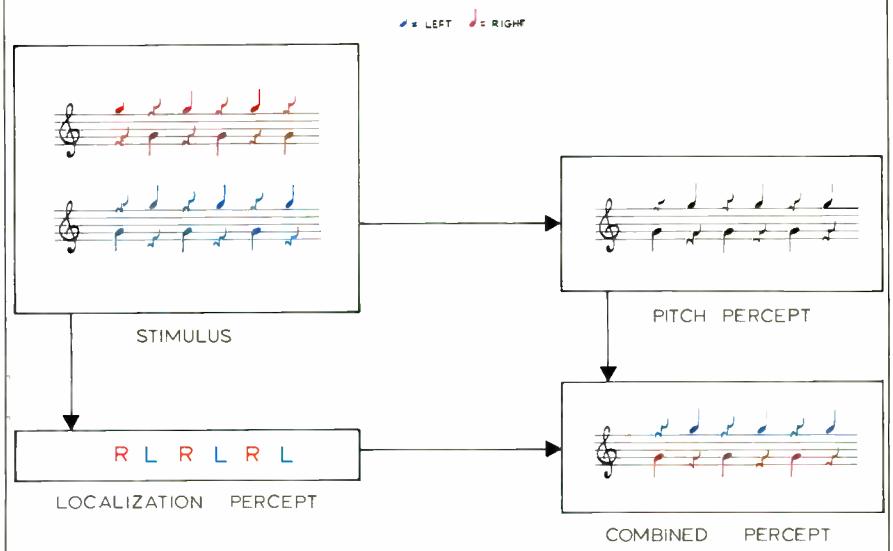


Fig. 4—Same as Fig. 3 but for "left-eared" listener.

The octave illusion pattern may be heard in analogous fashion to the way that we see ambiguous figures.

ground," *Neuropsychologia*, Vol. 21, 1983, pgs. 289-293.)

How do these findings relate to the organization of the brain in relation to handedness? In the large majority of right-handers, the left hemisphere of the brain is dominant (i.e., speech is processed primarily in this hemisphere). But this is true of only about two-thirds of left-handers, the remaining one-third being right-hemisphere dominant. We also know that people with left- or mixed-handers in their immediate family are less likely to have a pattern of dominance typical of right-handers than those with only right-handers in their family. So this pattern of results indicates that we tend to localize the tones in this illusion in accordance with our patterns of hemispheric dominance.

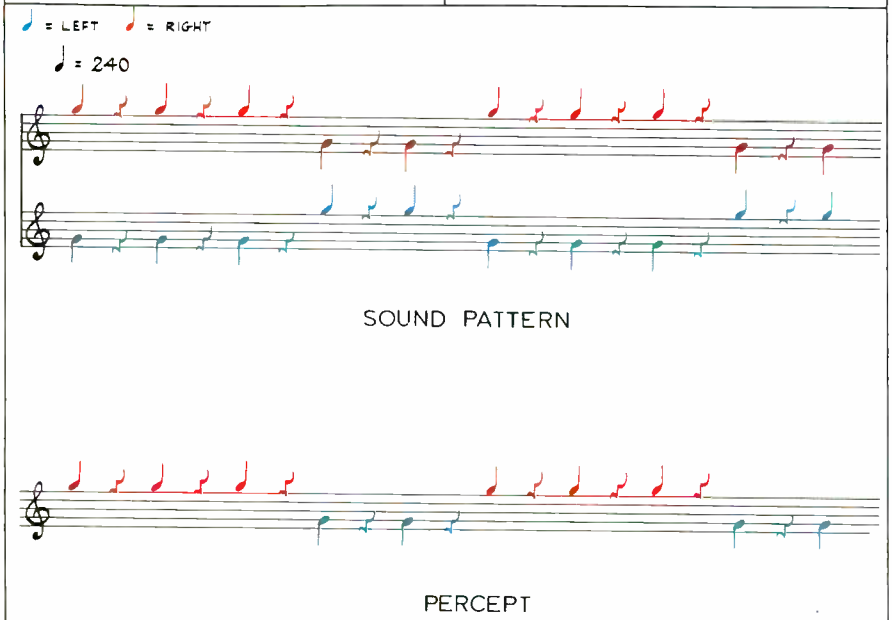


Fig. 5—Three high tones followed by two low tones delivered to right ear, simultaneous with three low tones followed by two high tones delivered to left ear.

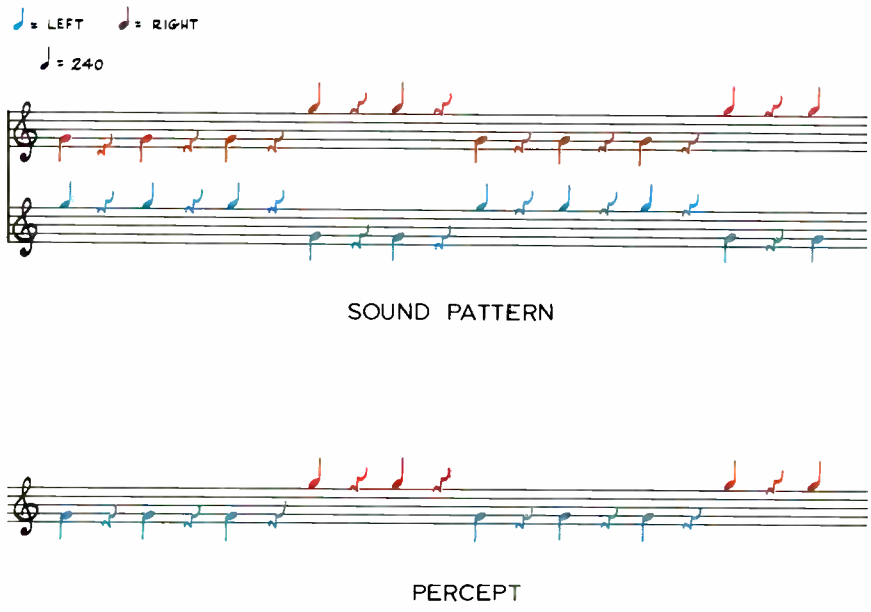


Fig. 6—Same as Fig. 5 but with earphone positions reversed.

Now, the perception of a single high tone in one ear which alternates with a single low tone in the other ear is most commonly obtained. But some people experience quite different illusions. Some hear a single tone which switches from ear to ear, and whose pitch either remains the same or changes only slightly as the tone appears to shift in location. Other people obtain a number of different complex percepts, two of which are illustrated in Fig. 8. For example, one person might hear a low tone which alternates from ear to ear and whose pitch shifts back and forth by a semitone, together with an intermittent high tone in one ear. Another person might hear a high tone alternating from ear to ear, with an intermittent low tone in one ear. Yet other people find that the pitches of the tones appear to change with continued listening. Large differences in timbre or sound quality are sometimes described; for example, the high tones may have a flute-like quality and the low tones a gong-like quality.

Complex percepts of the illusion are typically unstable, so a person may pass from one to another within a few seconds and describe the pattern as constantly changing its character. A considerably higher proportion of left-handers obtain complex percepts than do right-handers. This second handedness correlate is probably based on another relationship between handedness and brain organization. It concerns the degree to which one hemisphere of the brain is dominant over the other. In right-handers, there tends to be a pronounced dominance of the left hemisphere, but in left-handers, patterns of dominance tend to be less pronounced.

The illusion is sometimes perceived in a way that is analogous to the perception of ambiguous figures in vision. As illustrated in Fig. 9, the high tone may first be heard on the right and the low tone on the left. Then after a few seconds, the high tone will switch to the left and the low tone to the right. After a few more seconds, the tones will interchange positions again, and

so on. In a similar way, if we scrutinize the Necker cube of Fig. 10, it will appear to switch back and forth in orientation, so that the front face periodically changes places with the back one.

If you consistently hear the high tone on the right and the low tone on the left when the stereo channels are in balance, you might find that you can achieve a "Necker cube" percept instead by gradually altering the balance so as to increase the amplitude of the signal to the left ear relative to the right. At some stage, the high tone will suddenly appear to switch to the left and the low tone to the right. Having reached this stage, shift the balance back a little so as to reduce the amplitude of the signal to the left ear, until the tones appear to return to their original locations. By shifting the balance back and forth in this way, you may find a point of equilibrium at which the tones will appear to spontaneously interchange locations in space.

Playing with the octave illusion in this fashion is rather like scrutinizing some of Escher's woodcuts. Take, for example, his "Regular Division of the Plane III," shown in Fig. 11. In the uppermost portion of this picture, the black horsemen clearly provide the figure and the white horsemen the ground. In the lowermost portion, this situation is reversed. But in the middle, there is a region of ambiguity in which your perception alternates between these two interpretations.

What happens when the pattern is played at different speeds? Sound Example 3 presents the pattern first at the original tempo of four tones per second. Then the tempo is gradually increased to 20 tones per second, and finally it is slowed down to one tone every four seconds. You can hear the illusion sharpen as the tempo is increased, and gradually deteriorate as the tones are played more slowly. At the slowest tempo, both of the simultaneously sounded tones may be heard.

We may next ask what happens when the alternating tones are not in octave relation. Sound Example 4 presents the pattern with tones related by a minor third. You can hear that the impression is quite different, though an illusion is still produced.

What happens when the sounds are presented through loudspeakers rather than earphones? One experiment to investigate this question was performed in an anechoic chamber. The listener was first positioned so that one speaker was exactly on his right and the other exactly on his left, as shown in Fig. 12. When the octave illusion was played, a high tone appeared to be coming from the speaker on the right, and it appeared to alternate with a low tone coming from the speaker on the left. As the listener turned slowly, the high tone remained on his right and the low tone on his left. When, however, the listener came to face one speaker, with the other exactly behind him, the

1. With which hand do you write?	Right	Left	Either
2. With which hand do you use a tennis racquet?	Right	Left	Either
3. With which hand do you use a screwdriver?	Right	Left	Either
4. With which hand do you throw a ball?	Right	Left	Either
5. With which hand do you use a needle in sewing?	Right	Left	Either
6. With which hand do you use a hammer?	Right	Left	Either
7. With which hand do you light a match?	Right	Left	Either
8. With which hand do you use a toothbrush?	Right	Left	Either
9. With which hand do you deal cards?	Right	Left	Either
10. With which hand do you hold a knife when carving meat?	Right	Left	Either

Fig. 7—Varney and Benton handedness questionnaire.

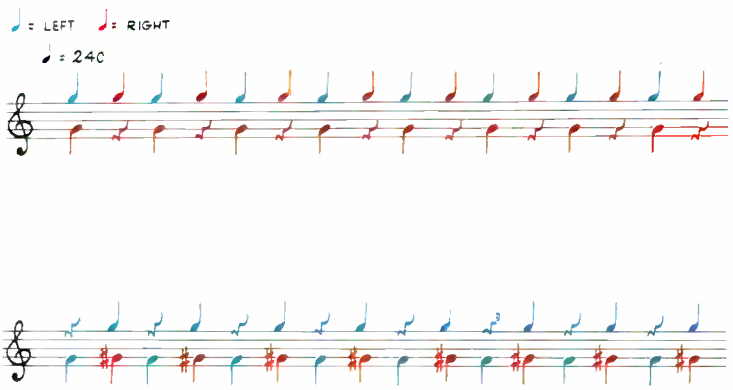


Fig. 8—Two alternative percepts obtained from octave illusion pattern.

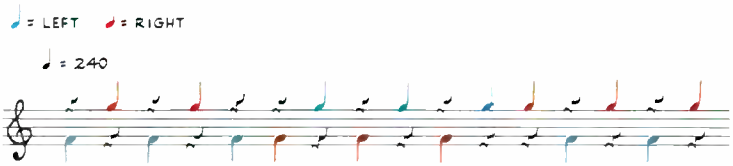


Fig. 9—Possible instability of percept obtained from octave illusion pattern.

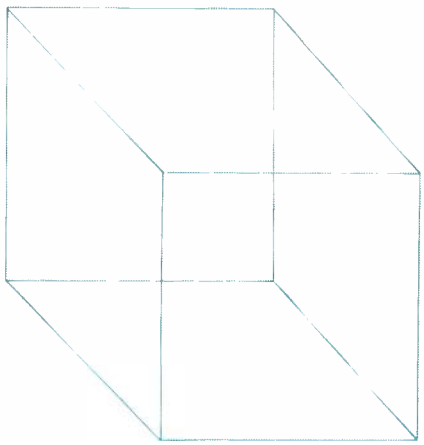


Fig. 10—Necker cube, illustrating instability of visual percept.

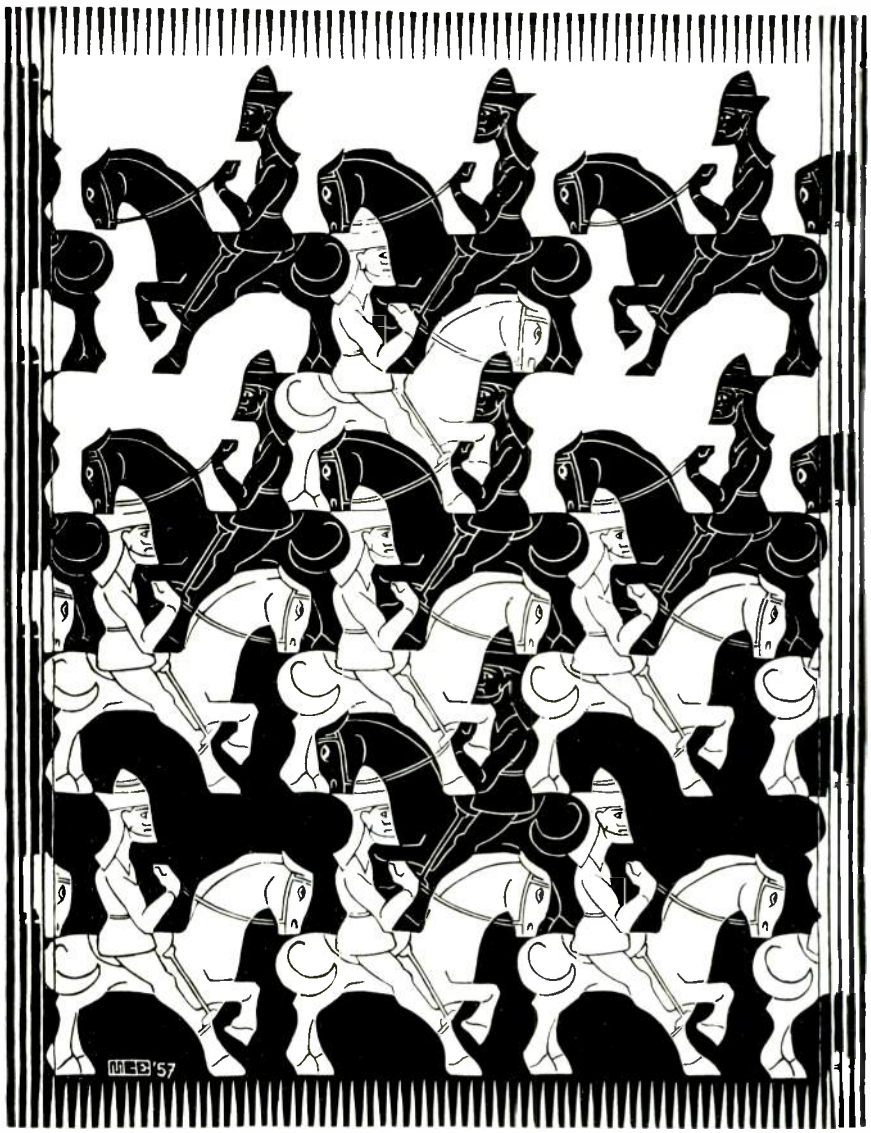


Fig. 11—Escher woodcut, "Regular Division of the Plane III," illustrating ambiguity of visual percept.

illusion abruptly disappeared; a single complex tone was heard instead, as though coming simultaneously from both speakers. But as he continued to turn, the illusion abruptly reappeared, with the high tone still on his right and the low tone on his left. In other words, after he had turned 180°, it appeared as though the speaker that had been producing the high tone was now producing the low tone, and that the speaker that had been producing the low tone was now producing the high tone!

The effect also works in certain nonanechoic environments, though the acoustics of normal rooms can degrade the illusion considerably. The following demonstration is, however, generally very successful: Begin by listening to the pattern with earphones in their usual position. Then, while the pattern is playing, slowly remove the earphones and bring them out in front of you, as illustrated in Fig. 13. If you obtain a clear and consistent illusion in the first place, you will probably find that you can bring the earphones out a considerable distance before the effect disappears. There is another point of interest here. Once the illusion is lost, it is necessary to return the earphones considerably closer (if not right back onto your ears) before it is recaptured.

What happens if, instead of two alternating tones, we present a more elaborate pattern? To examine this question, I devised the pattern shown in Fig. 14A and given in Sound Example 5. You can see that this consists of a major scale whose successive tones alternate from ear to ear. The scale is played simultaneously in both ascending and descending form; when a tone from the ascending scale is in one ear, a tone from the descending scale is in the other ear. Figures 14B and 14C show the ascending and descending components separately, and you can see that the pattern shown in Fig. 14A is produced by the superposition of the patterns shown in Figs. 14B and 14C. This sequence is played repeatedly without pause. (See Deutsch, D., "Two-Channel Listening to Musical Scales," *Journal of the Acoustical Society of America*, Vol. 57, 1975, pgs. 1,156-1,160.)

This scale pattern also produces a

Reversing the earphone positions does not usually reverse the apparent left/right location of tones.

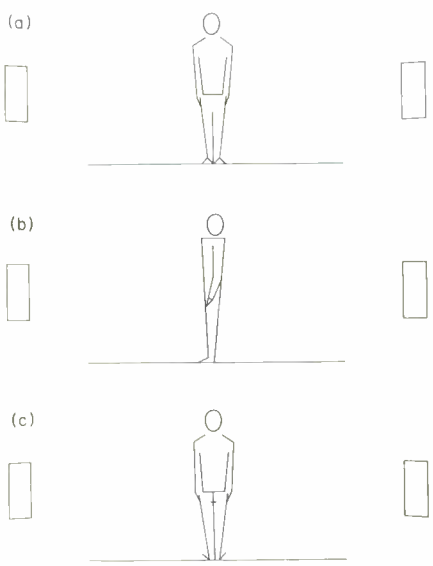


Fig. 12—Octave illusion using loudspeakers, with speakers exactly to left and right of listener (A), with speakers exactly in front of and behind listener (B), and after listener has turned 180° (C).

number of different illusions. The one most commonly experienced is illustrated in Fig. 14D. A perceptual reorganization occurs such that a melody corresponding to the higher tones appears to be coming from one earphone, and a melody corresponding to the lower tones appears to come from the other. When the earphone positions are reversed, the higher and lower tones usually maintain their apparent locations. So again, the procedure of reversing the earphone positions appears to cause the higher tones to migrate from one earphone to the other, and the lower tones to migrate in analogous fashion.

The ways in which the higher and lower tones are heard again correlate with handedness. Right-handers tend to hear the higher tones on the right and the lower tones on the left, but left-handers don't show this tendency. Some people hear only the higher tones, and little or nothing of the lower tones. Interestingly, among those who hear only the higher tones, a larger number are able to localize them correctly.

The scale illusion often works well with sounds presented through stereophonically separated loudspeakers in normal room environments. You may want to listen to Sound Example 5 this way, making sure you are situated roughly equidistant from the two loudspeakers. Whether or not the spatial effect works convincingly in your environment, you should certainly experience a perceptual reorganization of the melodic lines, such that when the channels are played together in stereo, the melodies that you hear are quite different from those that you hear when each channel is played separately.

Variants of the scale illusion can easily be produced. For instance, Sound Example 6 presents a two-octave major scale pattern, switching from ear to ear (or from loudspeaker to loudspeaker) in the same way as before. This pattern is illustrated in Fig. 15. When the two channels are played together in stereo, most people hear a higher scale which moves down an octave and back, and they simultaneously hear a lower scale, which moves up an octave and back, with the two meeting in the middle. But when you play each channel separately, the tones are instead heard to be jumping around over a large pitch range. Sound Example 7 presents another variation, a one-octave chromatic scale which alternates from ear to ear in the same fashion, as shown in Fig. 16. As yet another variant, Sound Example 8 presents a two-octave chromatic scale which alternates in the same fashion. This example is illustrated in Fig. 17. For all these variants (as well as for the original illusion), it is interesting to listen to each channel separately, and then to gradually equalize the balance of the channels and experience the two melodic patterns transforming into different ones.

Similar effects can even occur in listening to live music. Figure 18 shows a passage from the last movement of Tchaikovsky's Sixth Symphony. As you can see, the theme is formed of notes which alternate between the first and second violins, while the second voice alternates in converse fashion. A similar arrangement holds for the viola and cello parts. However, the voices are generally heard instead as illustrated on the right side of Fig. 18. It remains a mystery whether Tchaikovsky intended to create an illusion here, or whether

Fig. 13—Octave illusion can be sustained even with earphones in front of listener.

Illustration: Philip Anderson

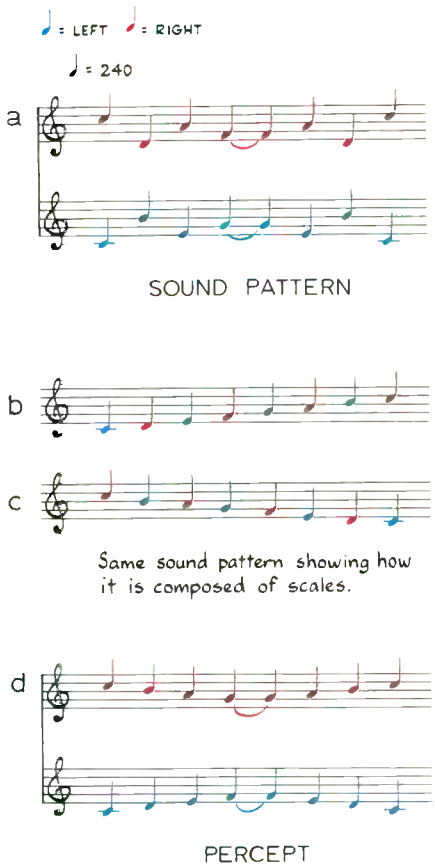


Fig. 14—Scale illusion using one-octave major scale. Sound pattern delivered to right and left ears (A), based on ascending and descending scales (B and C), produces an illusory percept (D).

Despite our conscious knowledge of an illusion, we may often continue to perceive what we hear incorrectly.

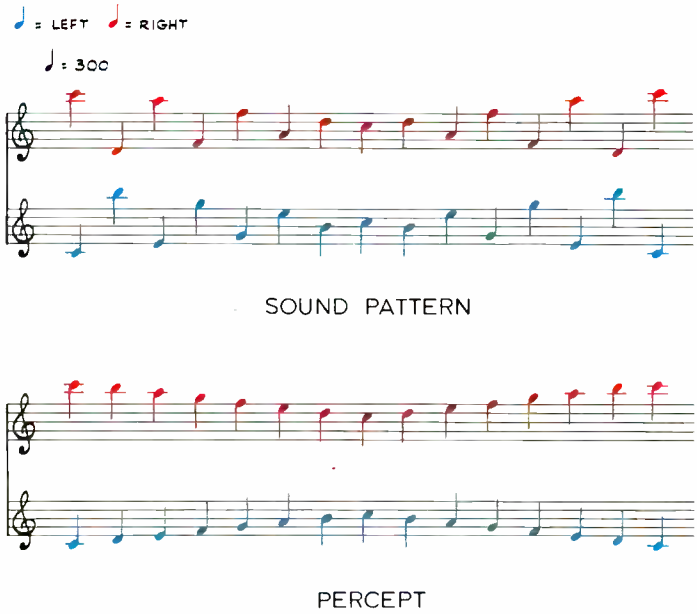


Fig. 15—Scale illusion using two-octave major scale.

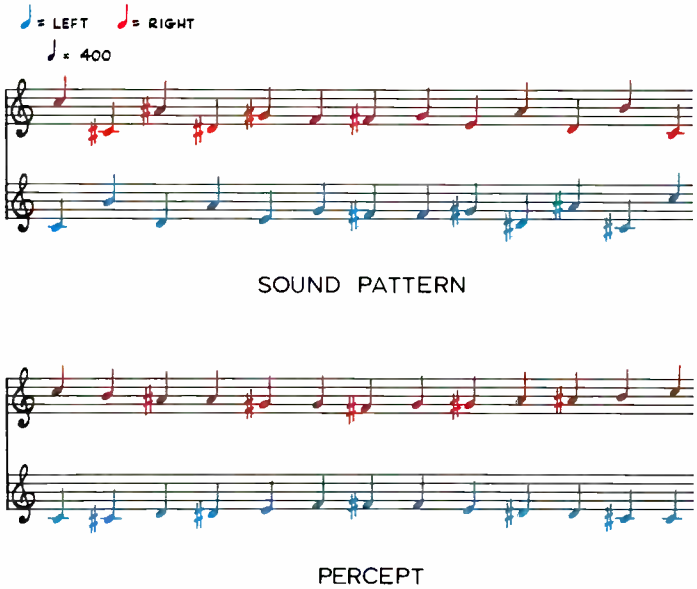


Fig. 16—Same as Fig. 15 but using one-octave chromatic scale.

he expected listeners to hear this passage as in the written score.

Why should we experience this illusion? Because of the complexity of our sound environment, we cannot rely on classical localization cues alone (such as differences in amplitudes and arrival times at each ear) to determine the locations of simultaneously presented sounds. Therefore, other cues must also be taken into consideration. One such cue is similarity of frequency spectrum: Similar sounds are likely to be coming from the same source, and different sounds from different sources. So with patterns such as we have been considering, it makes sense to conclude that tones in one frequency range are coming from one source, and that tones in another frequency range are coming from a different source. We therefore perceptually reorganize the tones on the basis of this interpretation.

There is an interesting visual analog of this effect. In Fig. 19, we see a photograph of a hollow mask, taken from the inside. Although the features of the face, such as the nose, are projecting inward, away from us, we perceive the face as projecting outward, towards us. Our expectations that faces should project outward are so strong that we perceive this picture quite incorrectly. Further, we continue to do so despite our conscious knowledge of the illusion.

So far, we have been considering cases where the sounds presented through the two earphones (or loudspeakers) are simultaneous. What happens when time differences are introduced? In one experiment, I devised two simple melodic patterns and asked listeners to identify on each trial which one they had heard. The patterns are shown in Figure 20.

In one condition, the tones comprising the patterns were presented to the two ears simultaneously, as shown in Fig. 21A. Under these circumstances the patterns were easy to identify, and performance on the task was very good. In a second condition, the tones were switched haphazardly between the ears, as shown in Fig. 21B. As can be heard in Sound Example 9, the switching procedure made the task much more difficult. Most people found that their attention was directed to the

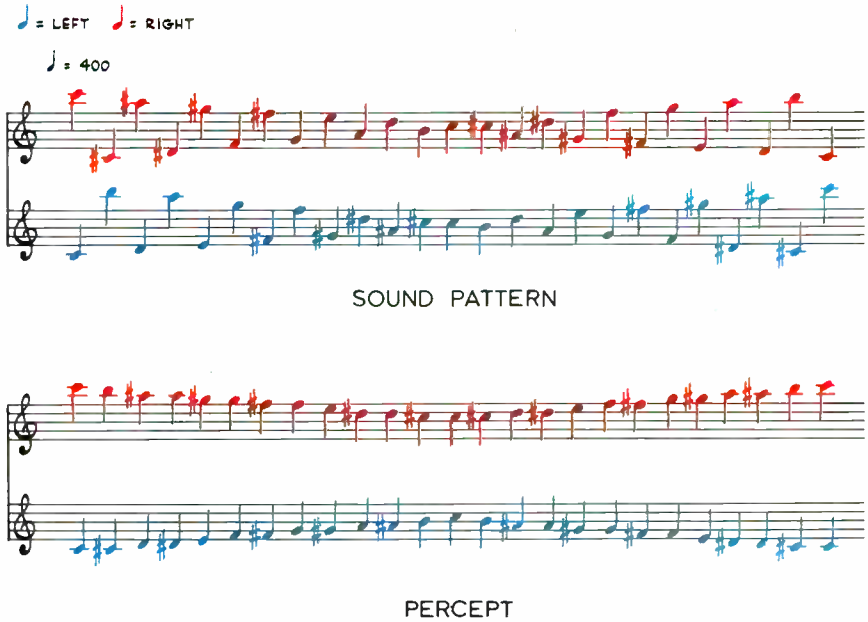


Fig. 17—Same as Fig. 15 but using two-octave chromatic scale.

sounds coming from one earphone or the other, and it was very difficult for them to integrate the two into a coherent melody.

A third condition (Fig. 21C) was exactly as the second, except that the melody was accompanied by a drone. Whenever a tone from the melody was in the right ear, the drone was in the left ear, and whenever a tone from the melody was in the left ear, the drone was in the right ear. So sounds were again presented to both ears simultaneously, even though the melody was still switching from ear to ear, exactly as before. As can be heard in Sound Example 10, the presence of the drone in the opposite ear caused the sounds to merge perceptually, so that the melody could easily be identified. Performance in this condition was again very good. In a fourth condition, shown in Fig. 21D, a drone again accompanied the melody, but it was presented to the same ear as the melody component. This meant that input was again to one ear at a time. As you can hear in Sound Example 11, it was again very difficult to integrate the different sounds. (See Deutsch, D., "Binaural Integration of Melodic Patterns," *Perception and Psychophysics*, Vol. 25, 1979, pgs. 399-405.)

This experiment shows that when signals are coming from two different locations, temporal relationships between them are important determinants of how they are perceptually grouped together. When both ears receive input simultaneously, integration of patterns is easy. But when sounds arriving at the two ears are clearly separated in time, we instead focus attention on one ear or the other, and find it much more difficult to combine the two into a single perceptual stream.

What happens in the intermediate case, where the signals to the two ears are not strictly synchronous, but instead overlap in time? In a further experiment, I found that this intermediate case produced intermediate results. Identification of the melody with a strictly synchronous drone in the opposite ear was easiest. Next easiest identification of the melody was with an asynchronous drone, while the worst results were with no drone.

Why should the perceptual system function in this fashion? Temporal rela-

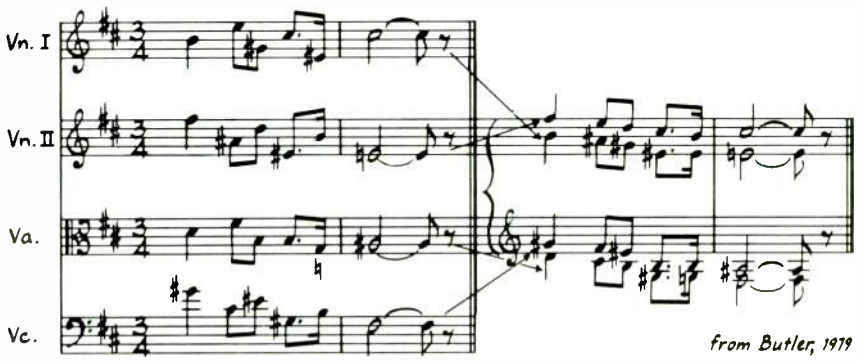


Fig. 18—Passage from last movement of Tchaikovsky's Sixth Symphony, showing separate parts for first and second violin, viola, and cello (left), and how these parts are usually perceived (right).

Photograph: Ben Rose

Fig. 19—A visual example of perceptual rearrangement: Hollow mask appears to project outward.

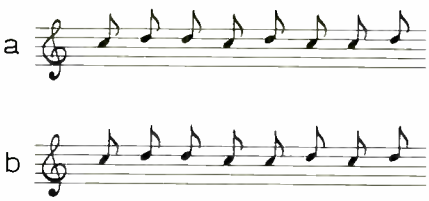


Fig. 20—Simple melodic patterns used to examine effects of time differences on perception.

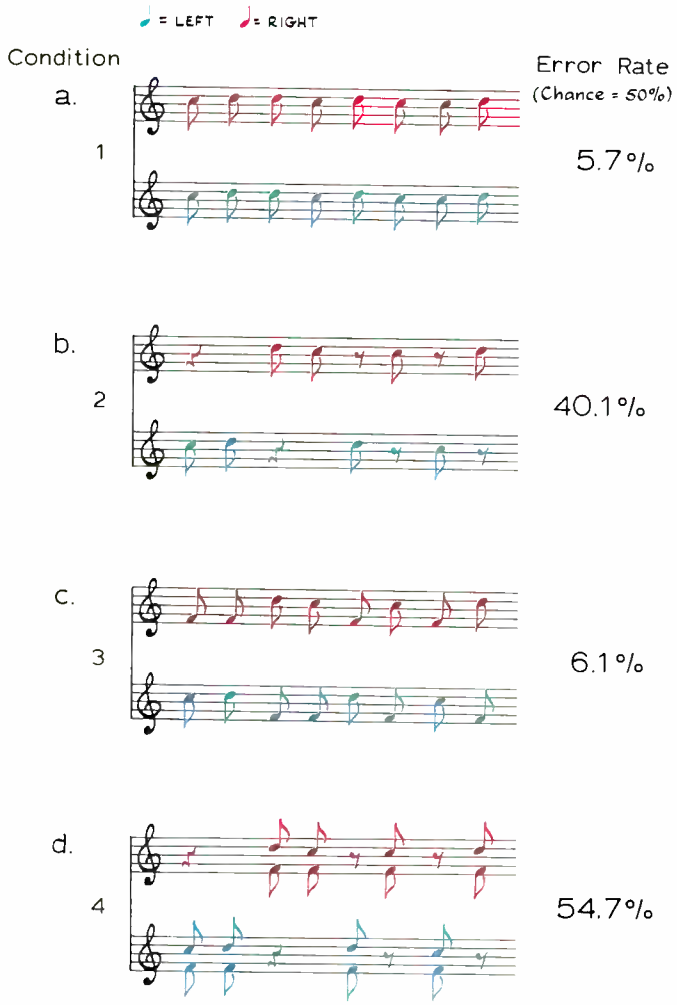


Fig. 21—Patterns of Fig. 20, with tones presented to two ears simultaneously (A), switching haphazardly between ears (B), switching haphazardly and accompanied by a drone in the opposite ear (C), and switching haphazardly and accompanied by a drone in the same ear (D).

tionships between sound signals provide important cues as to whether they are coming from the same source or from different sources. So we should expect that the more clearly signals at the two ears are temporally separated, the more we should treat them as coming from separate sources, and so the more we should tend to group them by spatial location. If such grouping were strong enough, it should prevent us from linking together sounds arising from these different sources.

To place these findings in a more general context, we may note that the composer Berlioz has argued for the compositional importance of spatial arrangements. As he wrote in his *Treatise on Instrumentation*:

> I want to mention the importance of the different points of origin of the tonal masses. Certain groups of an orchestra are selected by the composer to question and answer each other; but this design becomes clear and effective only if the groups which are to carry on the dialogue are placed at a sufficient distance from each other. The composer must therefore indicate in his score their exact disposition. For instance, the drums, bass drums, cymbals, and kettledrums may remain together if they are employed, as usual, to strike certain rhythms simultaneously. But if they execute an interlocutory rhythm, one fragment of which is given to the bass drums and cymbals, the other to kettledrums and drums, the effect would be greatly improved and intensified by placing the two groups of percussion instruments at the opposite ends of the orchestra, that is, at a considerable distance from each other.

The experiments that we have been describing indicate that spatial arrangements of instruments should indeed have profound effects on how music is perceived. When a rapid pattern of tones is distributed between two sets of instruments, and these tones are clearly separated in time, we may be unable to integrate them so as to form a coherent melody. If, however, the tones overlap in time, such integration is more readily achieved. But there is a trade-off: As the temporal overlap

The spatial arrangements of instruments should indeed have profound effects on how music is perceived.

is increased, our ability to identify the locations of the different sounds decreases, and when the tones are simultaneous, spatial illusions tend to occur.

Let us finally return to the question of how perception of simultaneous tones is affected by whether the higher tone is to the right and the lower to the left, or vice versa. As we have seen in the octave and scale illusions, right-handers tend to hear the higher tones on the right and the lower tones on the left, regardless of their actual locations. So combinations of the "high-right/low-left" type tend to be correctly localized, and combinations of the "high-left/low-right" type tend to be mislocalized. Other recent experiments have shown this to be true in more general settings also. And in further study I found that, in addition, there is an advantage to the "high-right/low-left" disposition in terms of how well the pitches of the tones are perceived. (See Deutsch, D., "Dichotic Listening to Melodic Patterns and Its Relationship to Hemispheric Specialization of Function," *Music Perception*, Vol. 3, 1985, pgs. 127-154.)

Now, to the extent that effects of this sort occur in listening to live music, we may advance the following line of reasoning. In general, seating arrangements for contemporary orchestras are such that, from the performers' point of view, instruments with higher registers tend to be to the right, and instruments with lower registers to the left. As an example, Fig. 22 shows a seating plan for the Chicago Symphony, viewed from the rear of the stage. In the string section, the first violins are to the right of the second violins, which are to the right of the violas. These are, in turn, to the right of the cellos, which are to the right of the basses. In the brass section, the trumpets are to the right of the trombones, which are to the right of the tuba. Notice also that the flutes are to the right of the oboes, and the clarinets to the right of the bassoons. The same general principle holds for choirs and other singing groups. Since it is important that the different performers in an ensemble should be able to hear each other as well as possible, we may conjecture that this type of arrangement has evolved by trial and error because it is conducive to optimal performance.

But this presents us with a paradox.

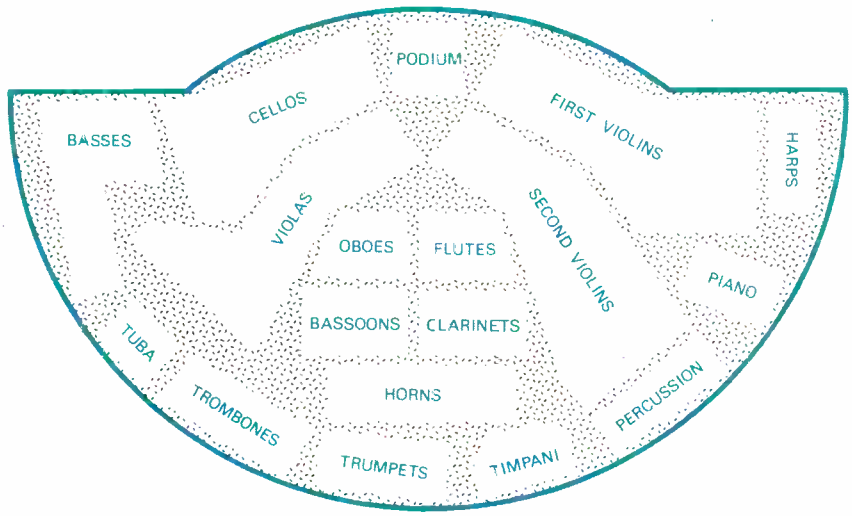


Fig. 22—Seating plan for Chicago Symphony, as viewed from rear of stage.

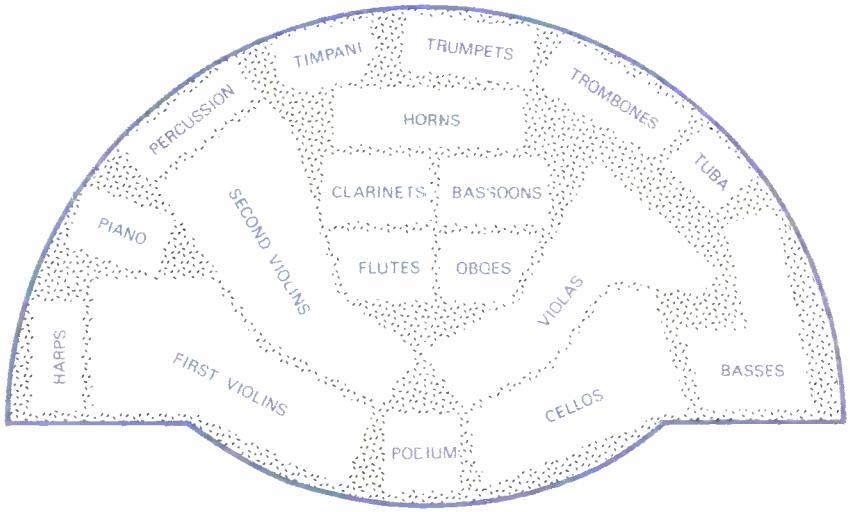


Fig. 23—Same as Fig. 22 but as viewed from audience.

Since the audience sits facing the orchestra, as shown in Fig. 23, this left-right disposition is, from their point of view, mirror-image reversed: Instruments with higher registers are now to the left, and instruments with lower registers to the right. So from the audience's standpoint, this arrangement is such as to cause perceptual difficulties. In particular, instruments with low registers which are to the audience's right should tend to be poorly perceived and localized.

It is not at all clear what can be done about this. We can't simply mirror-image reverse the orchestra, because then the performers wouldn't be able to hear each other so well. Suppose, then, that we turned the orchestra 180°, as a whole, so that the players

If a familiar melody is played with its notes displaced in different octaves, people will be unable to recognize it.

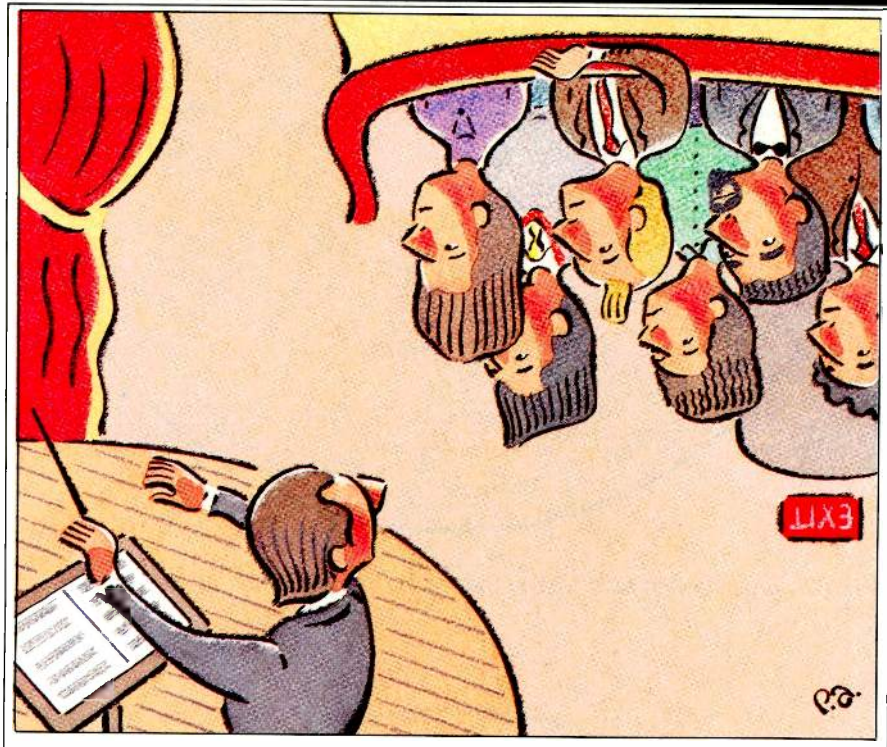


Illustration: Philip Anderson

Fig. 24—One way to optimize the left-right arrangement of an orchestra, both for the players and the audience.

had their backs to the audience. This wouldn't provide a solution, because then the brasses and percussion would be closest to the audience, and so would drown out the strings. Suppose, then, that we "retrograde-inverted" the orchestra so that they had their backs to the audience, with the brasses and percussion farthest away and the strings the closest. This wouldn't provide a solution either, because then the conductor wouldn't be able to hear the strings, and so wouldn't be able to conduct efficiently.

One solution (suggested by my colleage Robert Boynton) would be to leave the orchestra as it is, but have the audience hanging upside-down from the ceiling! (See Fig. 24.) This solution is, however, unlikely to be popular with concert-goers! On the other hand, for the case of sounds reproduced in stereo, an obvious suggestion presents itself: Try reversing the channels on your system. This solution is not without its drawbacks; the music won't sound the same as in concert halls, and the arrangement will be unfamiliar even as a reproduction. But you may want to try the experiment anyway.

Finally, I should mention that most of the perceptual effects described here occur even though the listener has full information as to what the sound pattern really is. There are other cases in listening to music, however, in which prior knowledge of the music has a profound influence on how it is perceived. One such effect, which I originally demonstrated using the tune "Yankee Doodle," is particularly striking. If you play a well-known melody, but displace its individual notes at random into different octaves, people will be unable to recognize the melody unless they are given clues on which to base a hypothesis (such as its rhythm, its contour, and so on). But if you give the listener the name of the melody beforehand, this problem essentially disappears. (See Deutsch, D., "Octave Generalization and Tune Recognition," *Perception and Psychophysics*, Vol. 11, 1972, pgs. 411-412.)

Sound Example 12 presents another well-known melody, with its tones placed haphazardly in different octaves in this fashion. Listen to this example, and try to identify the tune. Then listen to Sound Example 13, which presents the same melody without the octave-randomizing transformation. Finally, listen to Sound Example 12 again, and you will find that the melody is now much easier to follow.

This little experiment can also easily be performed by anyone with access to a musical instrument. Make sure, though, that you don't give your subjects any hints as to what the melody is, and that you scramble the octaves very well, or they might recognize the melody on the basis of a small part that was left intact. Also, choose a melody that is as free of rhythmic cues as possible, or they might be able to make the right guess on the basis of the rhythm alone. If you follow this procedure, it's pretty sure to work! A

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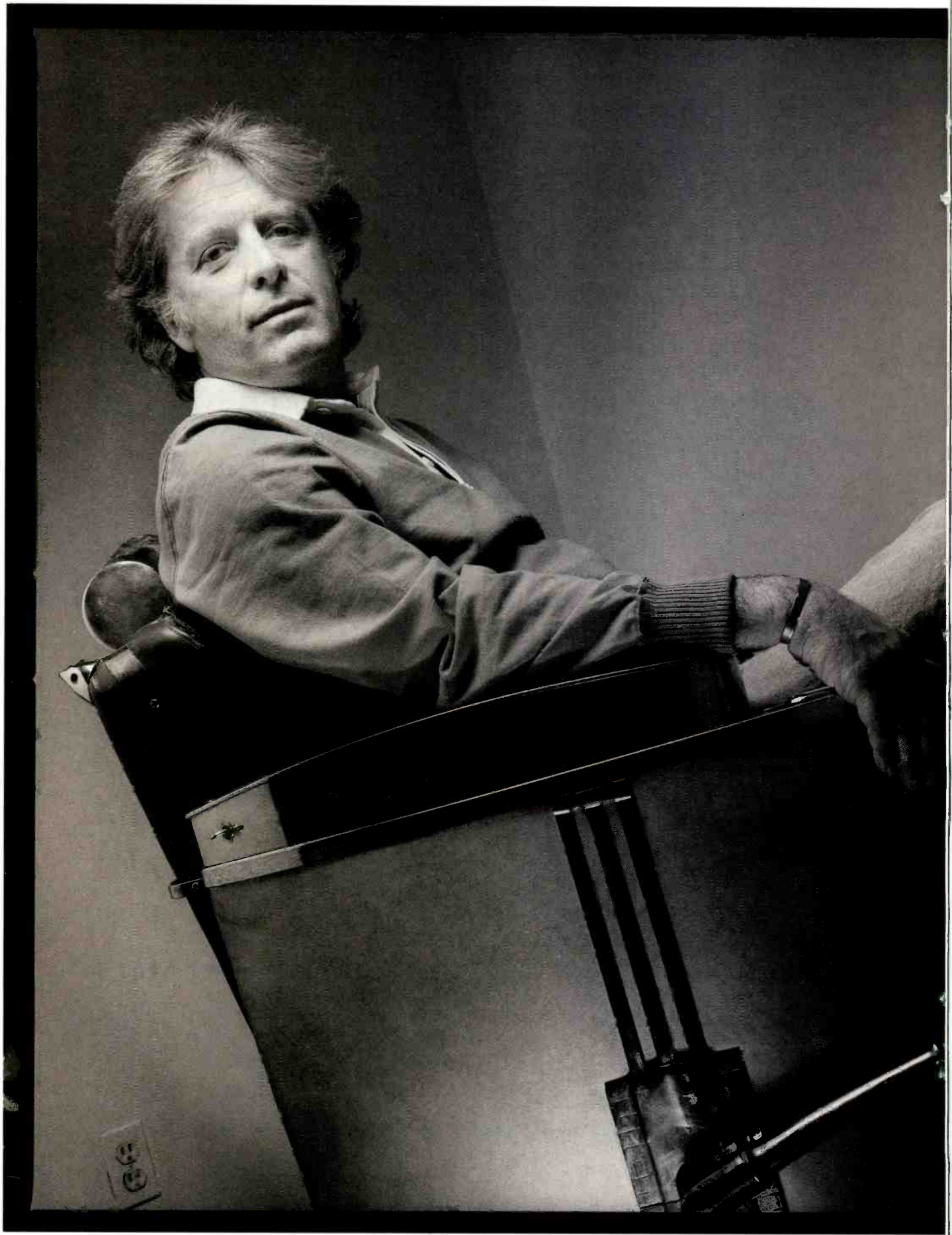
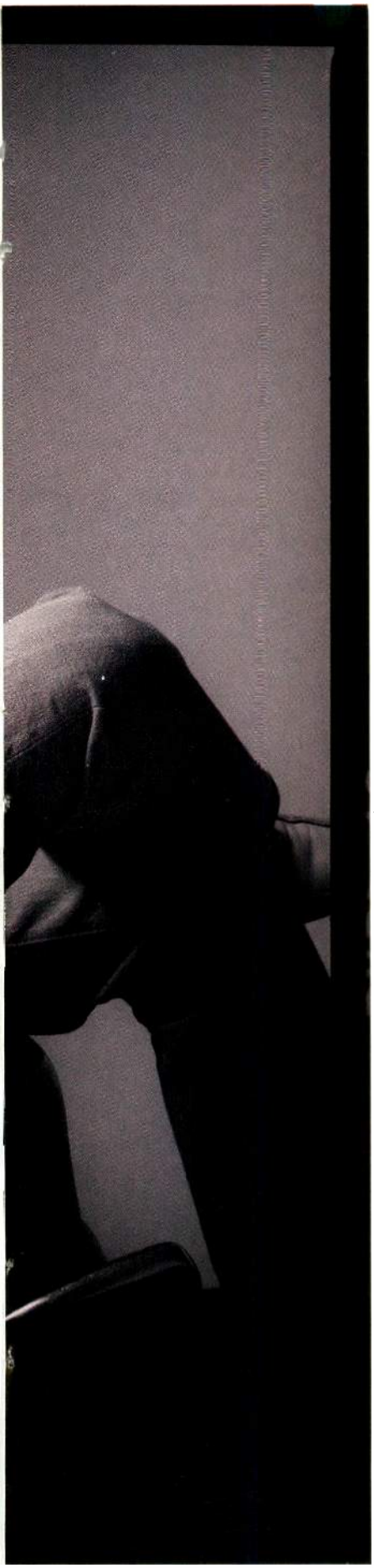




Photograph: Robert Lewis

Audio
INTERVIEW
PART II

CHRIS BLACKWELL: Treasured Island Chronicles

TED FOX

In this conclusion of a two-part interview, Island Records' Chris Blackwell discusses the currents and eddies in the pop music stream from the late '60s to the mid-'80s, when his roster included acts as diverse as The Wailers, Roxy Music, Frankie Goes to Hollywood and King Sunny Ade.

Did you ever feel that your loyalties were divided in the '60s between your rock groups and the Jamaican music you began with?

The artists from Jamaica I was involved with *as* artists during this period were Jackie Edwards, Millie Small, and Jimmy Cliff. A little bit Toots [Toots and The Maytals], also. Other than that, it was just [distributing their] records. I knew Toots then, but I really wasn't that involved in his career. Nobody really toured other than Jimmy Cliff or Millie. If there was a relationship, it would exist between me and Jamaican producers like Coxsone Dodd, Duke Reid, or these various characters. When I got involved in the rock side with Traffic and everything, I didn't involve myself at all with Jamaican music. Over a couple of years, I hardly even heard a Jamaican record because I was so involved in the other side.

Had you gotten bored with the sound?

I didn't get bored with it. It was more a matter of working with artists on the touring side—and management. It was just creatively rewarding to be working with artists in all aspects of their careers. We did it totally ourselves. Also, rock was the growth side of the company. It was more that *it* took *me*, rather than me driving it.

Bob Marley: "A rebel, a gangster, a street poet," says Blackwell.

I DON'T THINK people will buy a sound in general. They will buy an act, and once you have it working, you get more credibility to break other acts in that scene.

If you're successful in something, then people shower you with opportunities.

Let's talk about how you got back to Jamaican music. How did you become involved with the great film The Harder They Come*?*

It was partly written by a friend of mine, Perry Henzell. We'd been friends from kids in Jamaica. I'd been involved with him over the idea of doing a Jamaican film, and he always wanted to do it about this famous gangster character that existed in the late '40s and early '50s in Jamaica. During the course of a conversation with another friend of ours, Dickie Jobson, a guy who directed another movie called *Countryman*, it was decided to get Jimmy Cliff to play the lead. He was the hottest Jamaican act at that time. He'd just had *Wonderful World, Beautiful People*. Perry particularly liked the look Jimmy had on the album sleeve. I was also one of the major investors in the film.

What was the state of the Jamaican music scene in 1970?

The music was selling a lot in England. It was one of its most creative periods. There were lots of producers making records. It was the start of deejay music; all the kinds of sounds that are in contemporary black music today pretty much started in Jamaica. Dub music. Deejay music. Rapping music. I wasn't really that involved, other than being involved a bit with Perry in the selling and marketing of *The Harder They Come*. Around that same time, in fact, Jimmy Cliff left and signed with EMI. I was very upset at him leaving because, with the film, I'd now gotten back into Jamaican music and gotten excited about it again. I was spending more time in Jamaica. See, if I were to spend a month in Chicago, I'd come up with some acts from Chicago. I'd get involved, and see shows, and hear people. I was excited about where we could go with Jimmy Cliff from this film. I'd figured out in my head exactly where one could market and promote him. But we fell out because he felt that I had not done well enough for him.

I was so upset, and I really wanted another act to get into, and then Bob Marley walked in. I had released his records in England, but I'd never met him before. Bob came in, and Bob *was* that character that Jimmy Cliff played in the movie. He was a rebel. He was a gangster, if need be. But he was a street poet. He, Bunny [Livingston, later Wailer], and Peter Tosh. They all had this "f-you" type of attitude, but they were great. They weren't scary, but they had the essence of what any band should have—an attitude. A band should *know*. They should have their fingers on the pulse. A band like that is going to know what the public wants because they *are* the public—much more than anyone in the record company. I had always been told I should never deal with those guys. This was one of the groups that people didn't want to deal with; just like in *The Harder They Come*, it was too much trouble. That was the reputation The Wailers had. Nobody wanted to work with them. The trouble was that they knew what they wanted, and they didn't want to be treated like gardener boys, which is how the artists in Jamaica were generally treated. So I made a deal with them, and again everybody told me I was crazy. I gave them £4,000, cash, to go and make an album for Island.

Didn't you have to buy out their contract with CBS?

Yeah. They'd gone to CBS because they were with Johnny Nash, and he had a production deal with CBS. Everybody felt that the £4,000 would go and I'd never have an album. I felt that the only way to work with them was to . . . . You know, companies always say, "Trust us, sign here." Sometimes you can get badly burned by it, but sometimes it's good to put the trust out first. I don't say that The Wailers necessarily trusted me initially. But I think I had a reputation for being reasonably fair—more fair than most of the other people, let's say. A few months later, I went down to Jamaica and they picked me up at the hotel where I was staying. I went to the studio and they played me the *Catch a Fire* tracks and vocals. I still think it's one of the best records we've ever put out. Because I gave them my trust, I knew that every penny of my money was put into that record.

Was it your intention to break reggae music as a big new sound?

No. It was my intention to break Bob Marley, initially. You have to start with one particular act to be your flagship. I don't think people will buy a sound in general. I think they will buy an act,

and if that act has a different sound, they will look for other acts that have that sound. So when Bob was starting to happen, much of our promotion was "Bob Marley, *The Harder They Come*, reggae music, Jamaica." It made sense then to sign and develop some other Jamaican acts, because at the same time we were bringing journalists down to Jamaica to see Bob and see and feel the music, they might do an interview with Toots or Third World or Burning Spear or whoever else. Once you have one act and it's working, you get more credibility to break other acts in that scene.

I figured that Bob Marley could become as big an artist as Jimi Hendrix, as big as Muhammad Ali. I think he would have been. He was somebody who was just growing. The last album was done and I said, "I think we need two up-tempo tunes to balance out the overall feel of the album." He never said yes or no; he just acknowledged. I went away to Nassau, came back three days later, and he'd recorded two songs, "Could You Be Loved" and "Coming In from the Cold." He'd probably had them for ages. He had so much material in him. He was just becoming bigger and bigger. And he had no head problems because it had taken ages for him to get where he was. On the 1980 tour in Europe, he was always the first person on the bus in the morning. Unbelievable. Not one scrap of "big star" business—except that he was a disciplinarian. If somebody behaved badly, he would get very tough about it.

Initially, you didn't intend to produce Marley's records, right?

Right. Initially, I intended to work on the mix, which is what I did on all of them except *Survival*. From the beginning, I intended to work on the post-production of the record, after the basic tracks had been done. Then I'd come in and get involved and possibly suggest that another vocal be done or that some instruments be overdubbed. Bob basically did all the tracks and the vocal arrangements. He would fill up the music completely, with horns going all the way through, backing vocals all the way through. He would produce all the parts and ideas he had, then let me mix it. Then I would send it to him and he would say, "You left out a good part here," or whatever. Then I'd remix if he wanted me to.

On *Catch a Fire*, which is his most rock record, I worked a lot on the production side. I put the synthesizer on a couple of tracks and a rock guitarist named Wayne Perkins on a couple. I felt the first Wailers record needed to have musicianship in it, rather than just have rhythm and vocals. Reggae never had solos. You see, reggae music up until The Wailers was seen as a kind of novelty music in England. They'd have semi-comedy records. There was never any respect for the music or its musicianship. I felt that the musicianship was so extraordinary. When I signed the group, they were called Bob Marley and The Wailers, but when I put out the first record I called it The Wailers. I've been blamed for changing The Wailers' name to Bob Marley and The Wailers. It wasn't like that. When there were problems with Peter and Bunny, I put it *back* as Bob Marley and The Wailers.

Peter Tosh accused you of making Bob the star.

That's true. You see, I could never get on with Peter because he would say something and then not do it, whereas Bob and Bunny would really live up to their word. So once I saw how it could really happen and I realized that Bunny didn't want to tour and that Peter was erratic, I pretty much decided to change the group's name back to Bob

Jimmy Cliff, who played the lead in The Harder They Come.

Sly Dunbar and Robbie Shakespeare played with The Compass Point All Stars.

Grace Jones, whom Blackwell took from disco queen to New Wave act.

Marley and The Wailers, and then eventually drop The Wailers and really go after Bob Marley alone.

There seemed to be an initial surge in the reception of reggae when The Harder They Come ***came out. Then it seemed to come back again very strong in the late '70s. Is that how you remember it?***

Bob really broke strong in England in '76 or '77. He did a concert in London that really broke him. He was also big in America. That was around the time of an album called *Rastaman Vibration*. That was the highest chart entry he ever had; it got to number eight in America. It was very important to him to do well. He wanted to be number one, there was no question about that. He wanted to be as successful as possible, but on his own terms. He wouldn't run around and over-promote himself. He very much had a sense of a long-term career.

Did his increasing involvement with the Rastafarian movement cause problems for you?

No, not really. There were more problems caused by conflicting Rastafarian sects which were vying for his involvement. That really caused a lot of aggravation for him in the last few years of his life.

Do you think he was ill-advised about his medical problems?

Yes, he was definitely ill-advised. But on the other hand . . . . In 1977 he had this accident. He was told he had a [cancerous] lesion on his toe, and it should be checked every three months. We took him to a doctor in London first, and he said it should be amputated, and a doctor in Miami said it should be amputated. Then a doctor came from Jamaica—Babylon doctors, you know—and he said, "You shouldn't cut off your foot."

Because it was against the Rastafarian creed?

I don't know, but the Jamaican doctor recommended that it was not a good idea for him to have his toe cut off. I guess one is inclined to take that kind of advice. Really, this whole thing kind of faded from memory for all of us. I heard something about it, but I never realized how important it was. I guess if one had chased him up there and had it X-rayed, and had it checked every three months . . . . But nobody ever chased him or did anything about it. Everybody kind of forgot there was a problem. That was really what happened. And he ignored it.

Did reggae lose a lot of its impetus after he died?

Yes. It's a tiny country, Jamaica, two million people. Its music scene lost its leader—the leader who was so far ahead of the rest.

Was anyone as good as Marley?

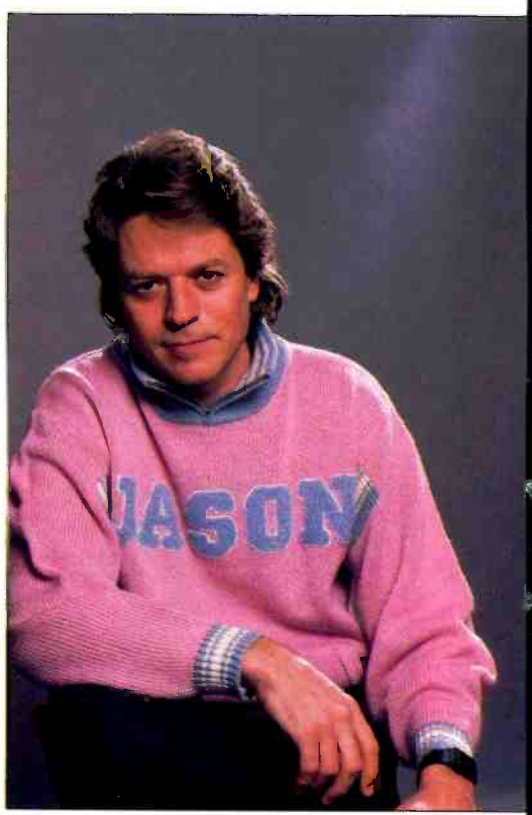
I think Jimmy Cliff is really talented. But he doesn't have the focus that Bob Marley did; he's not as clear. Jimmy's always been a little confused and not sure of which way to go. Toots is classic. But the thing about Toots is, he is so real in what he does that he is not really so easy to market and promote. Whereas his style is sort of in the style of James Brown, he doesn't have the kind of discipline that James Brown has . . . knowing how to pace the show, how to build the show. And that also goes for the recordings. Toots' best recordings are his most raw, natural ones, the early ones, which were all one-take records. I think it's also the band. Early on he had a band that was all enthusiastic and had great life. He's never been able to find a band since that early one which has the same kind of enthusiasm, drive, and energy. The other main problem that Toots had is that when Bob broke, synonymous with reggae were dreadlocks and the Rasta culture. Now, Toots is a Rasta, but not the sect that believes in growing your hair. So his hair is really tight, and his style suddenly became a sort of old-fashioned look. In terms of marketing and getting the kids involved in the fashion aspect, we weren't able to do it. I wasn't able to, and there hasn't been anybody else, as yet. But boy, he is a totally true person. A wonderful, wonderful person.

Let's talk about Sly Dunbar and Robbie Shakespeare, and what they do as producers.

I got involved with them quite late because they had worked with Peter Tosh, and Peter and I didn't get on. They were in a kind of alternative camp. It took a long time before I started working with them, but I'd known them a little bit for ages. They had tremendous ambition. They are like Bob in a sense. They want to be num-

Photograph: ©1981, Ebet Roberts

Robert Palmer "doesn't play the music business career game."



ber one; they want to work all the time.

Whatever happened to your attempts to put them together with James Brown?

It didn't work very well. The idea was Jerry Wexler's son Paul's. He was kind of my assistant while I was working with The Compass Point All Star Band. That was a band with Sly and Robbie that I put together for the Grace Jones record *Warm Leatherette*. That's when I started working with Sly and Robbie. It was a great band, and such an original sound that we felt all we needed was for someone to come in and we could work with their trip and enhance it and really give it something extra. It really didn't work with James Brown because he wouldn't record any song unless he at least had a piece of it. Sly and Robbie loved the idea of working with James Brown because he is a hero of theirs, but it wasn't something they were going to give up their songs for. The other problem was that Robbie and James Brown didn't hit it off at all. Robbie is a very tough guy, a lot like Bob, a sort of street fighter. It just didn't click. We tried some sessions and they were no good. We gave the tapes back to James Brown.

While your main interests in the mid-'70s were in reggae, you also signed Roxy Music at that time.

Roxy Music was brought to us by the managers of King Crimson and Emerson, Lake and Palmer. When I first heard the Roxy Music tape, I must say I wasn't that crazy about it. When I saw the album sleeve, I became very crazy about it. I could see the concept of what it was. I became friendly with the band later on. I suppose the one I became most friendly with was Brian Eno, and I know Bryan Ferry a bit. This was going to be a major band. They left eventually because they got a fat deal at Polydor. That's one of the problems of being an independent record company—competing against a major at the end of a contract.

When did you sign Robert Palmer?

I went to see a band called The Allen Bown Set, in about '70 or '71. Robert was the lead singer. I was really impressed with his talent and presence. I didn't really want the band, but I signed them because I wanted him. Unfortunately, he left the band a couple of weeks after that. He told me he wanted to join another band called Vinegar Joe. I told him I was much more interested in him as a solo act. However, he didn't feel ready to make a record on his own yet. Finally, about 1974, he came to see me and said he was ready to do his own record. He said he really wanted to do a record like The Meters did. So we sent him to New Orleans to work with [producer] Allen Toussaint. He cut the first album there with the New Orleans musicians and some of the people from Little Feat. That was *Sneakin' Sally Through the Alley*. It was one of the more successful first albums we've ever had. He did six or seven more albums until *Riptide*, which is his biggest so far.

How would you characterize him?

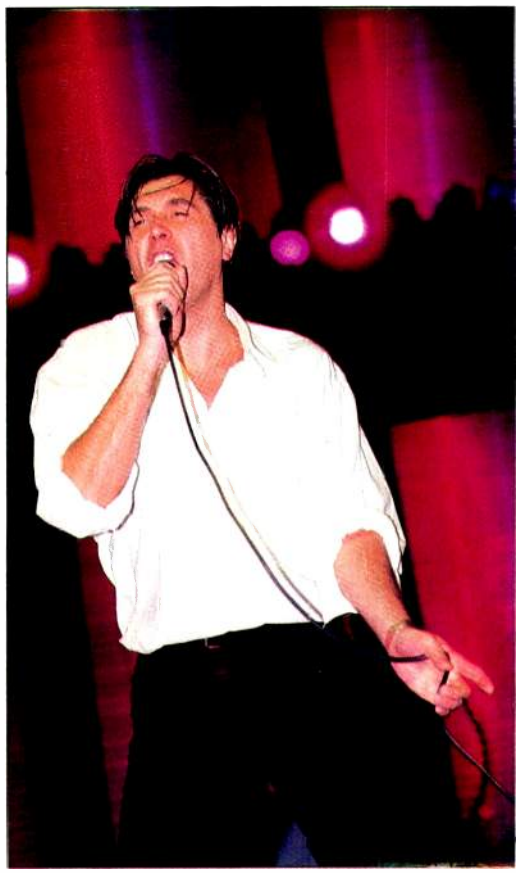
His records have been varied because he's really almost a musicologist. He collects records from all over the world—all kinds of outlandish records like Bavarian folk songs, Japanese music, African juju music. He draws his ideas from that music. Whatever he finds that he's interested in, is how he wants to direct his current projects. He's never been as big as people expected him to be. But he's been really happy with how everything has developed for him. He doesn't want to play the music-business career game.

Let's talk about Compass Point. Why did you set up that studio in Nassau?

Because at the time Jamaica wasn't stable politically, and the communications in Nassau are a lot better. Also, Nassau had become my home. What's good about Nassau is that when you take a break, you really have a break. There's nothing really happening there. The only thing you can do is lie in the sun. The place has very little personal character as such. If you were to go and make a record in Jamaica, you'd tend to try and make the people in the immediate vicinity react. The good thing about Nassau is that it's totally neutral. You can try any idea there, and you have a better shot. You'd probably reject it in any other place.

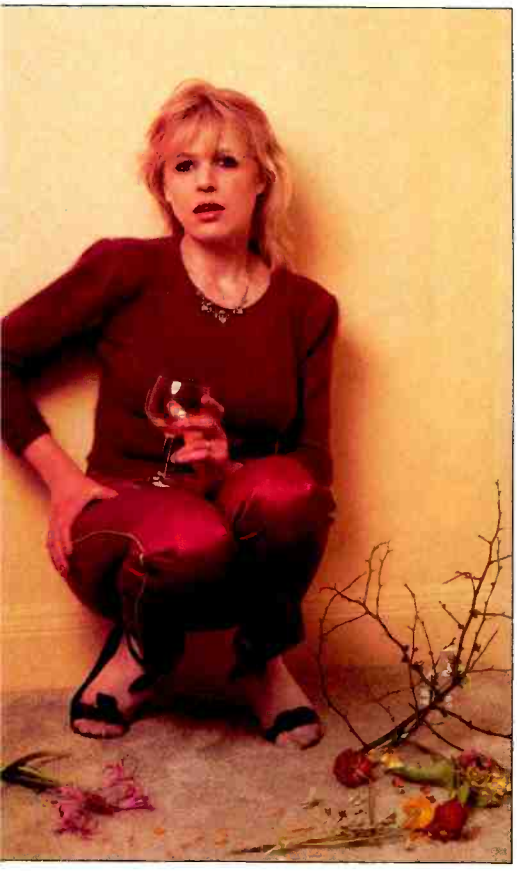
Tell me about some of the artists you signed when you branched out from reggae in the late '70s. Grace Jones, for instance.

I saw her in New York at the Russian Tea Room. Nik Cohn, the writer, was having a drink with her, and I think he



Bryan Ferry of Roxy Music, a band whose concept Blackwell loved.

ROXY MUSIC LEFT to take a fat deal at Polydor. That's one of the problems with being an independent record company—competing with a major at the end of a group's contract.



Marianne Faithfull's album was "one of the best Island ever put out."

invited me to meet her. She'd made a record already, "La Vie en Rose," and I loved it. We put that out, then the album that went with it. I didn't like the second album we did that much, and I liked the third one less. It was stuck in a disco-queen type of rut. I really felt that Grace was a black New Wave act. So I wanted to put a black New Wave band together. That was The Compass Point All Stars. At that time, the only new black music that was happening was reggae. Before we started recording, I pinned up the album-cover photograph Jean-Paul Goude had taken of her in a G.I.-type haircut, because it showed the image we wanted. I blew it up really big, and I said, "We've got to get a record that sounds like that."

Did you urge her into movies? She's a celebrity now from* Conan *and James Bond.

Definitely. That's where her future is, her strength is, as a visual artist.

Let's talk about Marianne Faithfull.

A guy named Mark Miller Mundy brought me a track called "Why Did You Do What You Did?" It was full of bad language, and I thought it was great. So I said, "Okay, I'll make you a deal for it." I was doubtful how the rest of the album would be, but he delivered the album [*Broken English*] and it's fantastic, one of the five best albums we've ever put out. We worked the record very hard. It was another of the ones like Bob's had been 10 years earlier. I felt, "This must sell immediately, it's so good." But we didn't sell anything much in America—60,000 or thereabouts.

Was she off drugs and rehabilitated when she was working on that record?

I wouldn't go as far as to say that, but Marianne is a survivor. We'll hear a lot of Marianne. I think she has a bigger future than a past.

How about the B-52's? Weren't they signed originally by Jerry Wexler at Warner Bros.?

No, they were not. I signed the B-52's in New York, and later on Warner Bros. signed them. One of the reasons they signed the B-52's, I think, was that I had signed them. They weren't that sure. When I signed them, I signed them for the world, excluding America and Canada. I didn't want to take on the responsibility of America and Canada. I didn't really figure out how I'd market them, so I only picked them up for the territories I felt sure they'd sell in. In fact, I was completely wrong.

I produced their first record in Nassau. They were very serious in the studio, very shy and retiring, but they had a very clear idea of what they wanted. With them, the kind of record I wanted to make was something that sounded like a live group. I think first records of new groups should not necessarily be incredibly refined. I think they should be more raw in feel. The songs should be good, and played well, and have an excitement to them. Even if there's a mistake, if the mistake enhances the excitement, it should definitely be left in. The main thing is to feel some excitement coming off the disc, because that makes people want to see the band. If your first record with a group is beautifully, perfectly produced, there hasn't really been a chance for the actual band to develop credibility. People are buying the record more than the band. I think a group almost has to recover from that. Frankie Goes to Hollywood is a classic example of this. Their first record was sensational. It was so good, but there was a serious question as to how good the band was. When that happens, a band has to spend the next period of time getting credibility.

What happened with Frankie Goes to Hollywood? You really dug them, didn't you?

Photograph: ©1980, Ebet Roberts

Frankie Goes to Hollywood is "recovering from starting so strong."

Yeah, definitely. I wish they had been better advised and everything. The whole thing happened so quickly. There were a couple of keys missing. There wasn't strong management at the beginning. There wasn't somebody with experience who could advise the band, the record company and the producers, and who could keep everything on course.

They seemed to be asking for it, coming to America with this gigantic hype. How did that come about?

It wasn't hype. What can I tell you? The thing is, their record came out and sold a huge amount in England. It was the fifth or sixth best-selling single ever. Then it was followed by the seventh or eighth best-selling single in England. So it wasn't really hype. It was there. The records were sold. They were incredibly exciting records. With that came all the T-shirts, which again came right off the street. They just happened. It was genuine; it wasn't hype. People just would kill for those T-shirts. Now in America you suddenly have all this attention, in a country that takes a long time to absorb something new which doesn't fit into black radio or AOR radio or whatever—something which has got a sound of its own—and it was very hard. So it was perceived as hype, and they walked right into it.

I saw their debut gig at The Ritz in New York, and my reaction, as well as the reaction of many people, was that they were the revamped Village People.

Yeah. Yeah. The Village People sold a lot of records—15 million. I agree. But there was no conscious attempt to recreate them. That's just how they were. We'll have another record soon, and it'll be great. They're actually very good. The problem is, they're recovering from starting so strong. Most bands that start that strong have a very tough time. [*Editor's Note:* At press time, Frankie Goes to Hollywood's second album, *Liverpool*, was in its eighth week on *Billboard*'s "Top Pop Albums" chart, having peaked at number 88.]

Let's talk about one of the best bands to come along in many years, U2. Were you the original person to sign them?

No. They were sort of brought into the company by Rob Partridge [Island's publicity head] in England. He's got a very, very good ear for whatever is new. He put the person who is in charge of A&R on to them, and he went to Ireland and met them. He rang me and said he wanted to sign them. I loved the name, so I said it sounds good to me, and we began to negotiate with them. I went to see them in London. They were clearly winners. Again, they were people who were thinking about their careers on a long-term, intelligent basis. They don't want everything now. They're in for the long run. They are exceptionally loyal people, the most loyal group of people you're ever likely to meet. Just about everyone who has ever worked with them is still some way involved. They've kept everyone, including the first fans they had.

Whose idea was it to put them together with Brian Eno?

That was their idea; I was violently against it. I went to see them because I felt that it was time to have a commercial hit record. As a producer, Brian had never cut such a record. He cut some great records, but never ones that were multi-platinum. U2's approach, and their logic for why they wanted to use him [as producer on *The Unforgettable Fire*], and all their reasons made sense to me—in the long run. I still didn't walk away feeling they were going to make a record that was going to sell three million copies. But on the other hand, I felt that in the long run it was a wise move; they wanted his intelligence. In the end, I loved the songs, but I was not that crazy about the sound of the record. I like their live performances of the songs better. I think they've grown considerably as a band since they made their last record, with all the touring they did. By the end of the touring, I loved every number much more on stage than I did on the record. Four or five of the strongest songs they'll ever come out with are on that record.

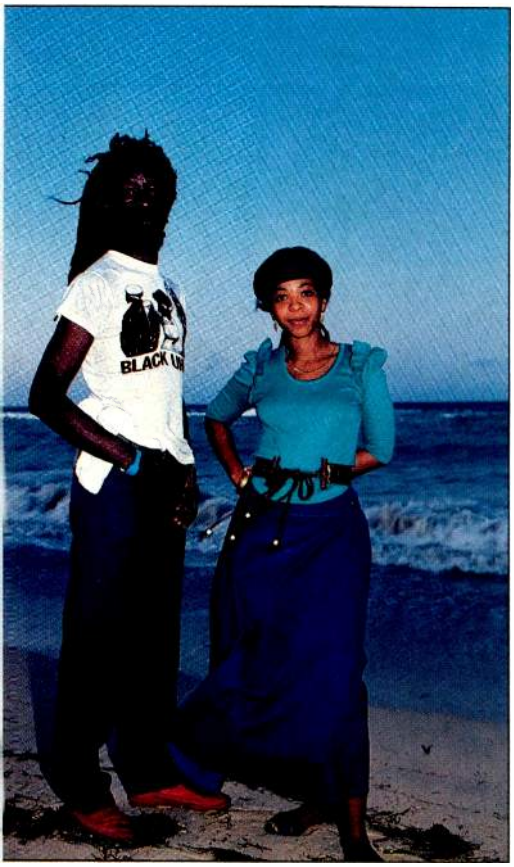
Now for something completely different—Malcolm McLaren.

Malcolm defies all description. I think his records are brilliant. The last one we put out [*Madam Butterfly*] . . . How people can't buy that album, it makes me so sad. The first album, *Duck Rock*—brilliant. But it's too varied. You see, I like literally all kinds of music, so when a record like *Duck Rock* comes out which has all kinds of music on it, I

Photograph: ©1981, Ebet Roberts

Malcolm McLaren, whom Blackwell says has "incredible ideas."

THE SEX PISTOLS and the whole punk scene in England was something that was necessary. It was a revolution of pop culture, which had gotten fat and gross.



Duckie Simpson and Puma Jones of Black Uhuru, a "hard, tough" band that Blackwell has compared to The Rolling Stones.

FIRST RECORDS of new groups shouldn't necessarily be incredibly refined; they should be raw. The main thing is to feel some excitement coming off the disc.

love it. The problem is that most people don't. Most people like a certain type of music; that's why they tune into certain stations. It wasn't news to me that *Duck Rock* didn't sell. His records are like bits of theater.

Many people think McLaren is simply a great charlatan.

I don't think he is. I am a big fan of his, in spite of the fact that he's written very negative things about me in the press. However, I'll put up with it because I think he's extremely talented. His ideas are unbelievable. There's nobody around as talented as he is in terms of their ideas. If you're somebody with a lot of ideas, as he is, and you have the energy, and the gift of gab, and drive .... If you're the manager of a group [McLaren created and managed The Sex Pistols and other bands], you don't go on stage. So at some time you're impotent; you can't do anything. So I can understand him calling himself an artist, as he does today. Why not? What he really is, is a conductor. He puts all these things together and releases them under his name. He talks a bit on the record, and maybe tries to sing. But you're not really buying him as an artist. He's asking, "What do you think of this as an idea?" I think he's got superb taste and style.

So he's not a con artist?

I think a con artist is someone who says he's going to sell you something and doesn't deliver the goods. I think he delivers the goods. When he delivered [the single of] "Madam Butterfly," I thought it was incredible. When he said he was going to do an album, I said, "I don't think it's a very good idea because I don't think you're going to be able to sustain it." But I think every track on that album is fantastic.

What he did with The Sex Pistols and the whole punk scene in England was something that was necessary. It was a revolution of pop culture which had gotten fat and gross. The essence of rock 'n' roll should be emanating from the streets, and have a sort of revolutionary-type edge to it. I liked the idea, but I never really liked The Sex Pistols because they just weren't musical enough at all for me.

How did you feel about the New Wave's early interest in ska and reggae?

I welcomed it because it gave this music credibility to a much wider market. Before, I was selling this music to Jamaicans and to liberals, hippies, and college students. Now a whole new market became interested. It was great.

Tell me about the terrific reggae band Black Uhuru.

They're the best. The story is that they don't talk to each other. It's stupid. Egos—stupid, ridiculous egos. Idiots, they're pure idiots. There's such a gap there right now for a band which is black and hard, and a little scary, tough. You want something with an edge to it. Black Uhuru was that. I'd see it when I'd go into a restaurant with them. Everyone would kind of clear out because they looked ... terrifying. Their name was scary. ["Uhuru" means freedom.] It reminded you of the Mau Mau or something. It was perfect. It's what The Rolling Stones were.

Who's coming along now in reggae?

I haven't heard anything recently. I think reggae is now part of world music. You hear bands from Australia like Men at Work doing reggae, The Police, Pretenders, everybody. Burning Spear and Toots have now become like John Lee Hooker, Muddy Waters or Lightnin' Hopkins—the originators. But Bob was so strong that afterwards people were a little lost. They didn't know whether they should try to *be* Bob. Before Bob, no reggae artists had any direction to follow, and they would be influenced by various bits of music from the rest of the world, and America particularly. Now the new ones are being influenced by other reggae artists. The whole strength of Jamaican music before was the fact that they'd listen to country stations, Miami stations, and so forth. They'd absorb all those things, kinda try to play it. It wouldn't come out right, but it would come out as something great instead. That was ska, and then reggae. Now they're either listening to disco or they're listening to Bob Marley's records. So they don't have anything of their own anymore. Now a song with a reggae rhythm is acceptable in pop music. It's good because that was brought from Jamaica. It's bad because one of Jamaica's main exports is floundering at the moment.

When you brought [Nigerian musician] King Sunny Ade over to America, was that an attempt to do for another type

Photograph: ©1982, Ebet Roberts

of Third World music what you had done for reggae?

Yeah. I think his situation is very similar. It's back to a whole different aspect of music—music and entertainment for partying and dancing and having a good time. It's not music that's necessarily going to be a structured show, it'll just start and roll.

How did you find out about King Sunny Ade?

Robert Palmer was very much into African music, and he played me some Chief Ebenezer Obey. I liked it very much, so I checked out the various African acts. I felt the one I could most likely work with successfully was King Sunny Ade.

What happened to King Sunny? He came in a big flash and then was gone. And he was great, too.

Management. It's very difficult to manage a band that lives in Nigeria and travels 25 at a time. Getting their records played on the radio is difficult, right? So you're not going to get a great, strong manager to get himself involved in something like that. He's going to work on something a little easier instead.

What about Island? Do you think you guys did enough to push King Sunny?

Well, yes. I think the problem was that there were things missing in his band, elements he should put into his band that, I thought, would really make it work. He should have three great African women singers—in African clothes, because the clothes are fantastic. In a second, one would have been able to break a whole black fashion aspect. It would have given the band an additional thrust. Because with music like that, or reggae, or any music that isn't on the radio, you have to keep the audience going. Unless that cult grows, and at one point crosses, it fades out. I feel I gave it a fair chance. If he had a manager who was together, I would do it again, if he had the girls. His shows are unbelievable, and I love the records.

You're getting more and more into film now. Your company produced Choose Me, *and more recently released* The Trip to Bountiful *and* Kiss of the Spider Woman. *What's the attraction of films for you?*

If you're in the entertainment business on the music side, I think you really need to be in films as well, because they're really joining into one business. You need to have access to putting your music into other people's films, and expanding the horizons of your artists into scoring, performing, or having their songs in films. I also feel that one needs to be in the film business in order to have access to people who are good video makers. *Good to Go*, in a sense, is a long-form video—some great music linked by a real story. The two industries are merging. It's a good thing. See, Roberta Flack might not have broken had it not been for her song ["First Time Ever I Saw Your Face"] in *Play Misty for Me*. The radio wasn't playing her records. The film came out a year later, and then she started selling. A song can register so strong in a film that you can break an act from that song.

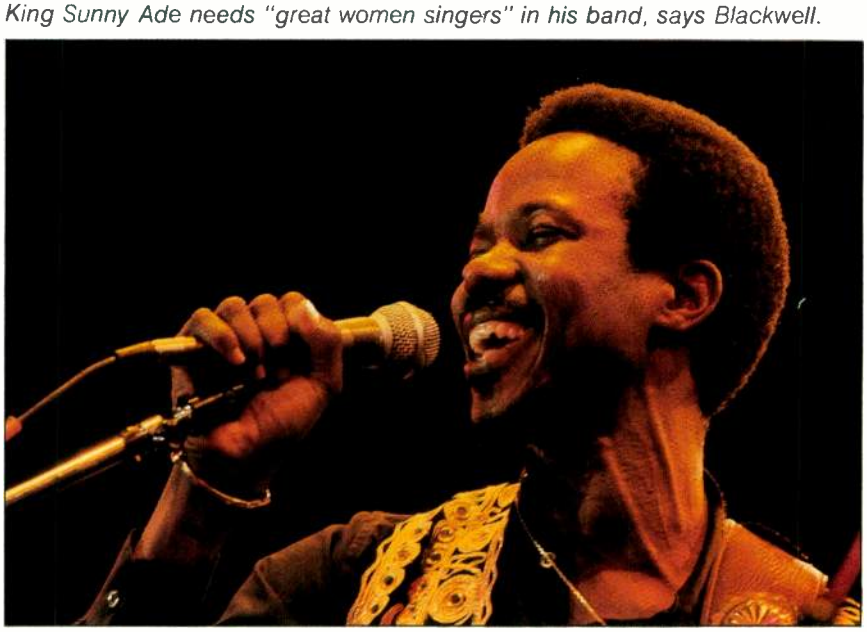
So how's Island Records doing these days?

It's having a hard time at the moment. It's struggling at the moment because we are in the middle of readjusting ourselves and our focus to the fact that I want Island to be a film and music company. But not with a lot of projects in either field. I think we expanded too fast in terms of acts and personnel. We tried to do too much. In fact, the right way is for us to work in close cooperation with a very strong, major company, thereby using its knowledge, clout, financial stability and help, while being able to offer the time, direction, and style that Island has in the signing and development of acts. At the moment we're still reeling through the fact that record-business economics has changed violently in the last several years. You never used to have to spend the kind of money you now spend for independent promotion. To get records on the radio costs an awful lot of money. It became more expensive because there are fewer stations that are important and it's more important to get your records played on those stations.

Are you talking about greasing somebody?

No, not at all. An independent promoter is like an agent. He will perform a function because he has contacts in that area, relationships in that area. Also, videos are a huge cost now. To really go after a hit single and take it all the way, a company like an MCA will spend a half-million dollars on independent promotion and a video for one song. That's one song, not one album. It's worth it if the act is right. If the act is right, what you're basically doing is spending a half-million dollars on commercials for that act. But you can't recoup it on one single or one album, unless you're incredibly lucky.

King Sunny Ade needs "great women singers" in his band, says Blackwell.



Photograph: ©Wendy Workman/Ebet Roberts

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Manufacturer's Specifications
Frequency Response: 2 Hz to 20 kHz.
Amplitude Linearity: ±0.01 dB, 20 Hz to 20 kHz.
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Dynamic Range: 96 dB.
S/N Ratio: 101 dB.
Channel Separation: 100 dB.
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Output Level: 2.0 V rms.
Number of Programmable Selections: 20 "blocks" (see text).
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It is to Magnavox's credit (or, more properly, to the credit of their parent company, Philips, the co-inventor of the Compact Disc system) that their very first CD players, introduced way back in 1983, employed digital filters and four-times oversampling. While other makers of CD players were employing steep analog output filters and a 44.1-kHz internal clock (one-to-one digital sampling), Philips continued to champion the four-times oversampling approach and the virtues of digital filtering. Gradually, more and more companies switched to oversampling and digital filtration, which is now the accepted standard for all higher quality CD players.

But even as companies have switched to digital filtering, most have opted to use two-times oversampling. Philips, starting CD player production back when reliable 16-bit D/A converters were hard to make, used 14-bit converters instead, and employed four-times oversampling to make up the difference in resolution. Other companies, starting when true 16-bit D/A converters were fast becoming available, used two-times oversampling. Philips chose to wait until better chips arrived before adopting 16-bit D/A converters—and has retained four-times oversampling even with the new converter chips.

The first unit using this best-of-both-worlds approach that I've had a chance to check out, the Magnavox CDB650, is absolutely superb sounding. Among many other internal circuit refinements, this player employs a special single-chip decoder and error-correction system: The single D/A converter chip actually contains two separate D/A converters, one for each channel, so there is no time delay between channels. There's not much time wasted in getting from one track of a CD to the next, either. The new low-mass laser-pickup assembly has so little inertia that it moves from track to track in 1 S or less.

While many of the circuit and structural refinements of this player account for its outstanding audible and measured performance, less technically oriented users will be equally enthralled by some of its unique convenience features. Perhaps the most talked-about new feature is what Magnavox calls FTS (for Favorite Track Selection). This not only lets you program your favorite selections from a disc in any order but also lets you automatically replay those selections, without reprogramming, each time you load that disc again. The system can memorize over 750 tracks; if you select an average of five tracks per disc, you can store enough information to handle more than 150 discs in this manner! There's no need to tell the player what disc you've loaded, for it "recognizes" each programmed disc's unique digital codes as soon as that disc is inserted. Magnavox does, however, provide a sheet of stick-on numerals that you can affix to the label side of the discs you've programmed into the FTS system; these numbers can be used for reference if you want to change or erase a specific program.

In addition to FTS, the CDB650 has more common programming abilities. Up to 20 selections can be programmed for whatever disc is currently playing. Unlike many CD players, this unit also allows you to program by index numbers (if such numbers have been encoded on your discs). However, because this requires a bit more memory than programming by track number, you cannot store quite as many index references as tracks. Finally, you can also program the player to start and stop at given times within a track by punching in the times on a keypad; the CDB650 is the first I've ever seen with this capability.

Another handy feature, for those of us who like to copy CDs onto tape (for use in our cars and portable tape players or for creating our own "albums" of selections from more than one disc), is a "Copy Pause" play mode. This interposes 4 S of silence between programmed selections, for the benefit of tape-search systems which use such pauses as markers. Other play modes include "Single" (the player stops after the current track is finished), "Auto Pause" (the player pauses after each track until the "Pause" button is depressed), and "Repeat," which can be used to repeatedly replay a complete disc, a program, or a short section of a track (whose beginning and end have been marked by pressing the "A→B" button).

The Magnavox CDB650 provides three sets of outputs for connection to audio systems. In addition to the normal analog outputs, which provide absolutely flat response, there is a second analog output pair which is filtered to gently roll off the highs above about 10 kHz. Those sensitive listeners who continue to mistake really flat response for "digital harshness," and any others who prefer a bit less high-end response, are free to plug into these extra output jacks if they want to.

Fig. 1—Frequency response through left (top) and right (bottom) channels of filtered output. Response deviations from unfiltered outputs were too small to be visible.

Finally, with an eye to the future, the Magnavox CDB650 provides a digital output—handling data as well as subcodes—for applications such as CM-ROM and digital signal processing.

Control Layout

The power switch is to the left of the slide-out disc tray. A large and elaborate display area to the right of the tray indicates track and index numbers, time elapsed on the current track, time remaining on the current track or the entire disc, the current play mode, and whether or not FTS is activated. Below the display area but above the major operating buttons are small, secondary pushbuttons. These select the play and time-display modes, allow you to review and check memorized programs, and activate "Scan" (which automatically plays the beginning of each track on the disc), the repeat-play functions, and FTS.

The numerical keypad, which is used for all programming modes and for direct play of individual tracks without programming, can be tilted out from the right end of the front panel when needed. Other controls for normal programming are on this keypad. After a program is entered here, pressing the "FTS" button stores it in the FTS memory for reuse whenever that disc is played again. The number keys are duplicated on the supplied remote control; this is the first CD player I've run across that offers number keys on both the panel and the remote.

The main operating pushbuttons, along the lower edge of

The superior performance made possible by 16-bit, four-times oversampling was obvious from the moment I began testing.

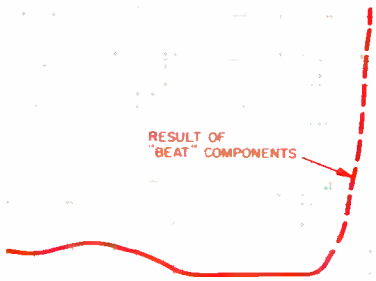
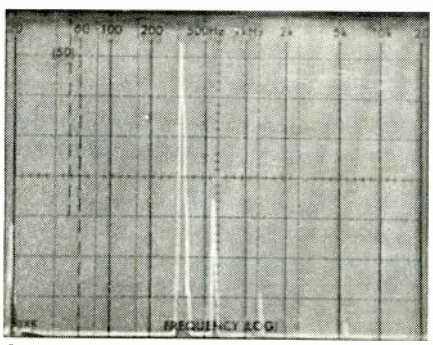


Fig. 2—THD vs. frequency at 0-dB recorded level. Dashed portion of line shows effect of out-of-band "beat" components rather than true distortion.



A

B

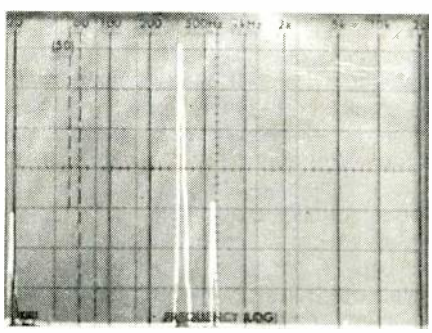


Fig. 3—Spectrum analysis of reproduced 20-kHz test signal from 0 Hz to 50 kHz, measured through unfiltered (A) and filtered (B) outputs (see text).

the front panel, are the "Open/Close" switch, "Stop," "Pause," "Play/Replay," forward and reverse "Search," and "Previous" and "Next" track buttons. The search buttons operate at three speeds, depending on how long you hold them down. At first, search is audible and slow enough for you to locate a specific point with 1-S accuracy. If you hold the button down, the search speeds up somewhat but the music remains audible, so this speed can still be used for fairly accurate location of a desired portion of a track. Finally, if you hold down either search button for about 10 S, the highest search speed is reached. The signal is no longer audible, and you must locate passages by using the time indications on the front-panel display.

A headphone jack and its associated rotary volume control are at the lower right corner of the front panel. The rear panel, in addition to housing the two different pairs of analog output jacks, is equipped with the digital output jack mentioned earlier and with a connector that links the CDB650's remote-control system to that of some other Magnavox components. The power cord for the unit is supplied separately and must be connected to the appropriate receptacle on the rear panel. Two shipping screws must be removed from the underside of the unit before the player will operate properly.

Measurements

The superior performance made possible by Magnavox's new 16-bit, four-times oversampling technique was obvious from the moment I put the CDB650 on the test bench and began measuring its performance using a new EIA-approved test disc. (This disc, by the way, is now available from CBS Special Products as *Test Disc CD-1*. [The price for the disc is $45 each plus $3 handling; write to CBS Inc., Columbia Special Products, 8th Floor, 51 West 52nd St., New York, N.Y. 10019.] It has all of the test signals needed for checking out a player in accordance with the soon-to-be-approved EIA Measurement Standards for CD Players.) Frequency response of this player, measured from the normal outputs, was so flat that to present a graph of response curves would have been meaningless. You wouldn't be able to see anything, since the response line would fall on the horizontal calibration line corresponding to "0 dB" for each channel. As nearly as I could determine, response was flat to within less than 0.1 dB over the entire audio range. I was able to plot the player's response when outputs were derived from the additionally filtered outputs. As you can see in Fig. 1, the effect of these filters is precisely what Magnavox intended it to be: The response through the filtered outputs was down by a bit less than 1.0 dB at 10 kHz and was about 2.5 dB down at 20 kHz.

Harmonic distortion at maximum recorded level was just under 0.002%; more important, it remained at this low, low level over most of the audio range, as shown in Fig. 2. As usual, the dashed line in the region above 10 kHz in Fig. 2 does not represent harmonic distortion. Rather, it arises primarily from the presence of a single inaudible "beat" above the audio band, as seen in Figs. 3A and 3B, which show the spectrum from 0 to 50 kHz. The signal from the "flat" output jacks (Fig. 3A) shows the 20-kHz test signal, the major out-of-band component that almost always ap-

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Unweighted S/N was a very high 100.0 dB, the highest I've ever measured, and A-weighted noise was too low for my instruments.

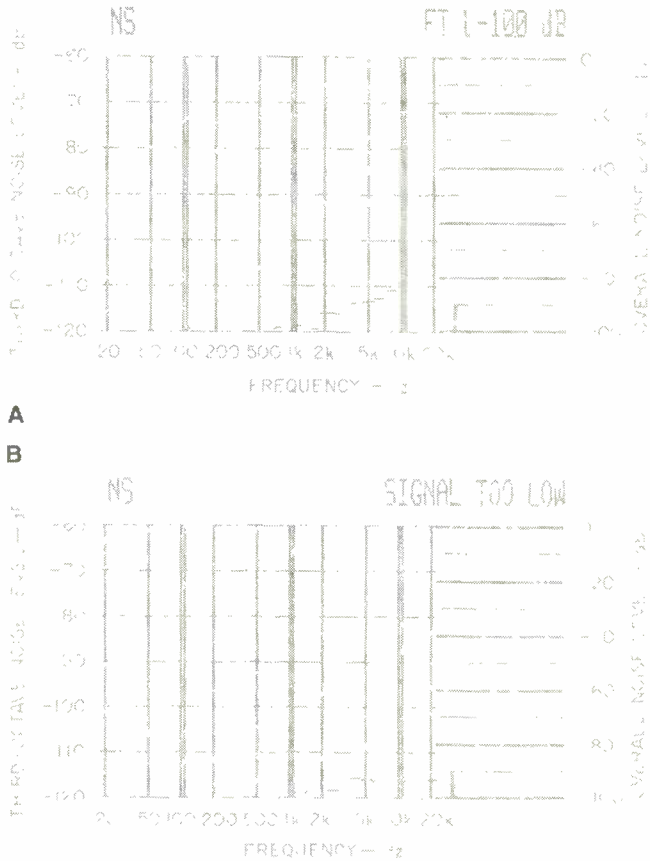

Fig. 4—S/N analysis, both unweighted (A) and A-weighted (B).

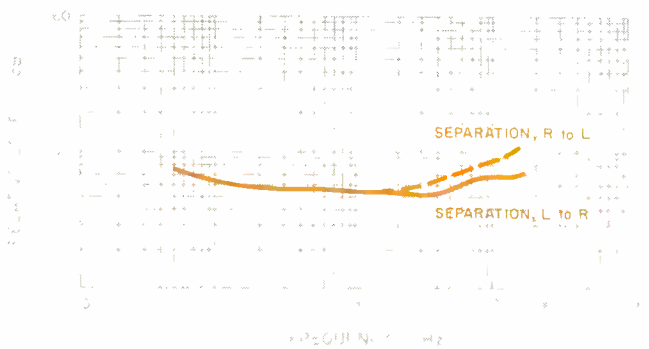

Fig. 5—Separation vs. frequency.

pears at around 24.1 kHz in this test, and a couple of low-level spurious components in the vicinity of 30 and 40 kHz. The signal from the filtered outputs (Fig. 3B) shows a very slight roll-off of the 20-kHz test tone and only a slight decrease in the 24.1-kHz out-of-band beat tone. However, those extra components at the still higher out-of-band frequencies are no longer visible within the dynamic range of the spectrum analyzer. Regardless of which outputs were used, the 24.1-kHz major beat was of very low amplitude, especially when compared to poorer quality CD players.

Figures 4A and 4B show the analyses of unweighted and A-weighted signal-to-noise ratios for the CDB650. The unweighted S/N (Fig. 4A) was a very high 100.0 dB (the highest I have ever measured for any CD player). As for A-weighted noise, it was simply too low for my test instrument to register; hence the notation "Signal Too Low" in Fig. 4B. Dynamic range was a never-before-achieved 115 dB! (In CD testing, dynamic range is not synonymous with S/N. The figure for dynamic range is obtained by measuring the difference between maximum [zero] recorded level and the THD amplitude generated by a 1-kHz tone at −60 dB; S/N is the difference between zero level and the noise floor.) Linearity was nearly perfect, all the way from maximum recorded level to −80 dB. De-emphasis, when activated by a disc which had been recorded with pre-emphasis (only a few use this additional noise-reduction technique), was accurate to within 0.1 dB over the entire audio frequency range. SMPTE-IM distortion measured less than 0.003%, and CCIF IM was even lower, with a reading of 0.002% at maximum recorded level and rising to 0.006% at −10 dB recorded level.

Stereo separation, plotted as a function of frequency in Fig. 5, was close to 85 dB at mid-frequencies and remained around the 80-dB mark even at 16 kHz, the highest frequency at which this characteristic is measured using the new test disc. Maximum output level from the player was 2.06 V; this level was identical in both channels. Short-term access time (the time it takes the laser pickup to move from one track to the next) was no more than 1 S, and long-term access time (the time it takes to get from an inner to an outer track) measured approximately 3 S.

A 1-kHz square wave, as reproduced by the CDB650, is shown in the 'scope photo of Fig. 6. Like the square waves reproduced by other players that use digital filtering and oversampling, it is close to perfect. The departure from a perfectly flat top in the reproduced waveform is due to the absence of higher order harmonics and not to any ringing or overshoot which might have been present if steep analog low-pass filters had been used. The impulse signal shown in Fig. 7 further confirms the fact that excellent digital filters have been used in this unit.

I am now using a new approach for measuring time delay or phase error between left and right channels: I apply the output of one channel to the horizontal input of a 'scope (the X axis) and the output of the other channel to the vertical input (Y axis). If the signals from both channels are perfectly in-phase, a straight line tilted 45° from lower left to upper right should appear on the screen. As you can see from Fig. 8, that's exactly the result I got when reproducing a 20-kHz signal at the left and right outputs of this CD player.

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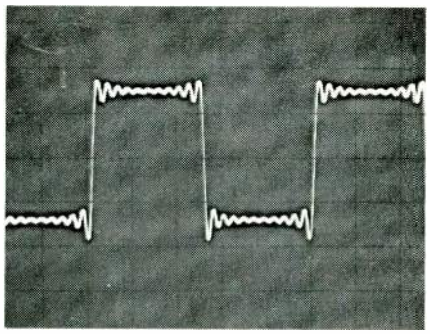

Fig. 6—Reproduction of a 1-kHz square wave.

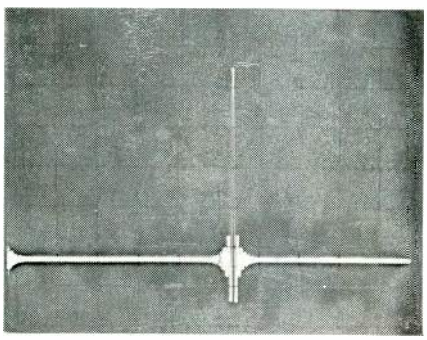

Fig. 7—Single-pulse test.

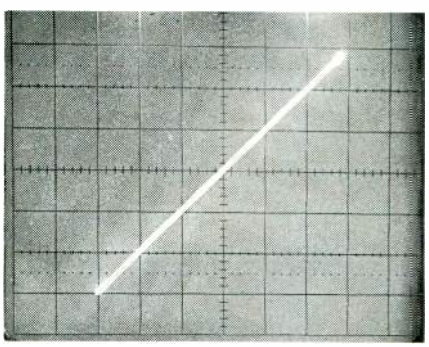

Fig. 8—Interchannel phase comparison at 20 kHz. Absence of interchannel phase error is indicated by 45° angle of Lissajous pattern on 'scope (see text).

Use and Listening Tests

When I first put a disc into the CDB650, the display showed the total number of tracks and total playing time. Other displays were almost self-explanatory, and for those who haven't had much experience using a CD player, the brief but complete owner's manual makes everything clear after a few minutes of reading. After playing some of my favorite discs on this machine, it was clear to me that here was a true state-of-the-digital-art component. Remember the overenthusiastic claim made by Magnavox in 1983: "Perfect Sound Now and Forever"? Well, now the company has come up with a machine that comes very close indeed to realizing that early promise.

Nor is the CDB650 a particularly finicky machine. I subjected it to some rather violent vibrations during some of my listening tests, and it neither muted nor mistracked. Disc-drawer action is smooth and precise when loading and unloading discs. Programming and using FTS is simpler than it appears to be when you first read the manual. Once I got the hang of it, I was fascinated by the player's ability to "recognize" the discs I fed to it. Of course, here Philips is simply putting to good use some of the identification data that is part of the standard CD encoding format they helped develop in the first place. Every disc has its own digital identification code; the FTS system stores this code during programming and uses it to select the proper program when that disc is played back. Pretty clever, those microprocessors, aren't they? Some may regard such frills as superfluous, but I don't think that anyone listening to the CDB650 will be able to deny that it is among the best-sounding CD players—if not *the* outright best sounding one—yet to be produced by any company. And surprisingly, its suggested price belies its quality.

It almost goes without saying that the player was able to handle my special "defects" discs without any mistracking or muting. Once again, I couldn't refrain from digging back for some of my earliest acquired CDs—the ones that I and others had summarily dismissed as being overly strident and harsh-sounding—and replaying them on the CDB650. A few of the dozen or so discs that fall into this category still were not as musically accurate-sounding as I would have liked, but surprisingly, about three-quarters of them suddenly sounded significantly better. I know that this was not my imagination, since I also played them on an early-generation player that I keep around for just that purpose. The difference is real, and I must attribute the improvement to the digital filtering, the extremely linear 16-bit D/A converters, and the other circuit refinements that have been built into this unit.

It's no secret that small, dedicated audio manufacturers such as Mission, Meridian, and Distech have consistently used early Philips CD players as the starting points for most of their own high-end models, making internal circuit modifications in an effort to achieve better sound. I wonder if that trend will continue and whether some of these manufacturers will now start modifying the CDB650 or its Philips equivalent. Frankly, I think if they do they may be wasting their time. I honestly can't see how they can improve on what the people in The Netherlands have come up with.

Leonard Feldman


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2

JVC RX-9V A/V RECEIVER

Manufacturer's Specifications

FM Tuner Section

Usable Sensitivity: Mono, 10.3 dBf.
50-dB Quieting Sensitivity: Mono, 14.8 dBf; stereo, 38.3 dBf.
S/N Ratio: Mono, 84 dB; stereo, 78 dB.
THD: Mono, 0.08% at 1 kHz; stereo, 0.08% at 1 kHz.
Frequency Response: 30 Hz to 15 kHz, +0.5, −0.8 dB.
Capture Ratio: 1.5 dB.
Alternate-Channel Selectivity: 70 dB.
Image Rejection: 90 dB.
I.f. Rejection: 100 dB.
Stereo Separation: 50 dB at 1 kHz.

AM Tuner Section

Sensitivity: External antenna, 30 μV; internal antenna, 250 μV/m.
S/N Ratio: 50 dB.
THD: 0.5%.
Selectivity: 38 dB.
Image Rejection: 40 dB.
I.f. Rejection: 65 dB.

Video Section

Output Signal Level: VCR out, 1 V peak to peak at 1-V peak-to-peak input.
Impedance: 75 ohms.
Synchronization: Negative.
S/N Ratio: 45 dB.
Crosstalk: 45 dB at 3.58 MHz.

Amplifier Section

Power Output: 120 watts continuous per channel, 20 Hz to 20 kHz, both channels driven into 8-ohm loads.
Rated THD: 0.007%.
SMPTE IM: 0.007%.
Damping Factor: 45 at 8 ohms, 1 kHz.
Input Sensitivity for Rated Output: MM phono, 2.5 mV; MC phono, 250 μV; high level, 230 mV.
Recording Output Level: 230 mV.
Frequency Response: Phono, RIAA ±0.5 dB, 20 Hz to 20 kHz; high level, 5 Hz to 50 kHz, +0, −1.0 dB.
S/N Ratio: MM phono, 80 dB; high level, 77 dB.
Equalizer Center Frequencies: 63 Hz, 160 Hz, 400 Hz, 1 kHz, 2.5 kHz, 6.3 kHz, and 16 kHz.
Equalizer Control Range: ±10 dB.

General Specifications

Power Consumption: 120 V, 60 Hz, 410 watts (510 VA).
Dimensions: 17⅛ in. W × 5 in. H × 15 in. D (43.5 cm × 12.65 cm × 38.1 cm).
Weight: 23 lbs. (10.4 kg).
Price: $720.
Company Address: 41 Slater Dr., Elmwood Park, N.J. 07407.
For literature, circle No. 91

I'm beginning to wonder whether the race to integrate audio and video components into comprehensive home-entertainment systems isn't leading to designs that are altogether too complicated for the average music lover to operate. When you take your first look at JVC's newest and most powerful (120 watts per channel) audio/video receiver, you'll probably wonder how its designers managed to cram so many features into a single, relatively compact unit.

The RX-9V receiver is intended to serve as a master control center for a variety of audio and video components. You can connect a turntable, a Compact Disc player, and a cassette deck. The audio and video tracks of a VCR or a videodisc player can also be fed to this unit, and its audio and video outputs can be connected to a TV monitor as well as to the recording inputs on a VCR. Two sets of speakers can be connected to the receiver, and either or both sets can be switched on, as desired. If you subscribe to cable TV, you can connect your cable to one of the antenna inputs on the back of the receiver while the other antenna input accommodates your regular FM antenna. Alternatively, since front-panel switching between antennas is possible, you can connect two FM antennas to the system, each oriented in a different direction.

The supplied remote allows you to control most of the RX-9V's functions from the comfort of your listening/viewing chair. Furthermore, if your system includes certain other compatible JVC components (such as some of their CD players, cassette decks, and turntables), you can turn on and control their functions with this remote, which the company has dubbed the CompuLink remote-control system.

The operating features of the receiver itself are mind-boggling, to say the least. The RX-9V is equipped with a seven-band graphic equalizer rather than with simple bass and treble tone controls. Not only can you store five of your preferred response settings in the receiver's memory, but you can also select five factory-preset response curves. These five preset curves have been created and permanently stored for such material as rock music, music with vocals, background music, movie soundtracks, and vocal-only programs. At the touch of a switch, the bar-graph-like indications used to set response curves are transformed into a real-time spectrum analyzer which lets you see the tonal or spectral content of the music to which you are listening.

Built-in microprocessor circuits, in addition to providing the functions you would expect, perform certain "judgmental" tasks as well. For example, if FM stereo reception is too weak or noisy, a circuit called QSC (Quieting Slope Control) is activated, reducing background FM noise at the expense of some stereo separation. Many tuner sections allow you to preset your favorite stations for instant recall, but the JVC tuner section goes farther. It can be told to scan for stations whose signal strength is adequate *and then store* the frequencies of those stations. (You determine what signal strength is adequate by dialing in a dB figure.) If the tuner stops at a station you'd rather not store, you can bypass that signal. Up to 16 station presets can be programmed in this manner.

Among its other audio signal-processing circuits, the RX-9V has an "acoustic expander" circuit; this simulates stereo spread for mono signals and tends to increase apparent separation when you are listening to stereo program material. A loudness-compensation control is also available for use during low-level listening.

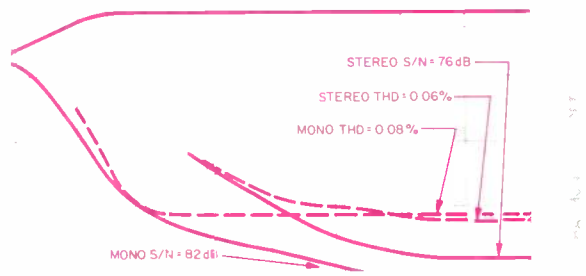

Fig. 1—Mono and stereo quieting and distortion characteristics, FM section.

Control Layout

As was true of earlier JVC receivers, there is not a single rotary knob (or any other kind of knob, for that matter) protruding from the sleek, highly graphic front panel. All operating controls are pushbuttons. Three major illuminated, colored display areas occupy much of the front panel's upper section. The first of these is devoted to the graphic equalizer and spectrum analyzer, which JVC continues to designate as an "SEA" (Sound Effects Amplifier) section. Below this display are the various pushbuttons needed to alter overall response settings, and those needed to call up memorized response curves. To the left of this display are the power switch, speaker selector buttons, and the usual stereo phone jack.

The second, more centrally positioned display area provides a wealth of information concerning selected audio and video program sources, status of the two tape monitor circuits, volume and balance settings, and other audio functions. This area serves as sort of a flow-chart diagram for the various signals you have chosen to send along to the various outputs. Incidentally, it is possible to watch one video program while listening to a completely different audio source. This feature makes simulcast viewing and listening extremely convenient. Program selector buttons are found below this display.

The third display area is dedicated primarily to the tuner. It shows tuned-to AM or FM frequencies, signal level, selected antenna input, signal strength in decibels, tuner preset number, and the "stop" level for the scanning/preset func-

Response was flat all the way up to 15 kHz, quite a feat when you consider that 19-kHz rejection was nearly 70 dB.

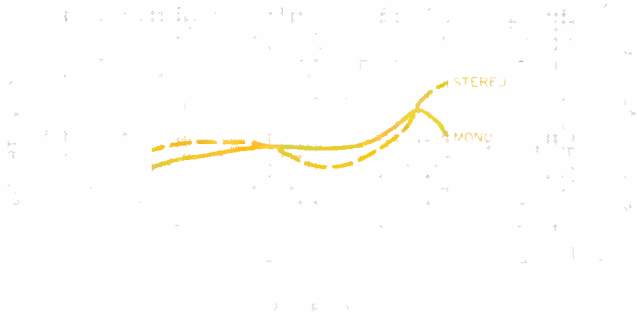

Fig. 2—THD vs. frequency, FM section.

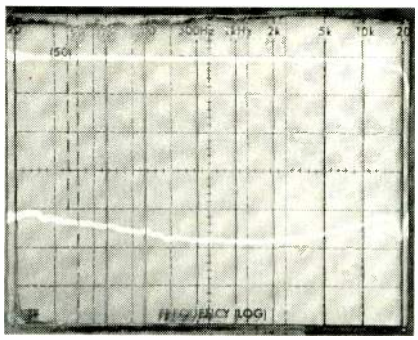

Fig. 3—FM frequency response (top trace) and separation vs. frequency (bottom trace).

tion described earlier. Tape monitor switches and various other audio control buttons are found below this display area. Farther to the right are buttons that control volume level, channel balance, and tuning. Numbered station-preset buttons and other controls associated with the tuner section are also located at the panel's right.

At first glance, the fully lit front panel seems a bit intimidating and complex, but the owner's manual clears things up quickly. I found that after an hour or so of using the RX-9V, the logic of its layout became apparent. From then on, it was easy to use all of its facilities, either via the front panel or from the remote control.

On the rear panel, audio inputs and outputs are grouped together, as are video-component inputs and outputs. Two separate video inputs (along with their audio track inputs) are provided, in addition to input and output connections for a stereo VCR. A separate TV monitor can also be connected. In addition to the usual 75-ohm FM antenna connector, the AM antenna terminals, and the supplied AM loop antenna, there are 75-ohm coaxial connectors for an incoming cable-TV line and for making an r.f. output connection to a VCR. As I mentioned earlier, the second r.f. input can be used, alternatively, for connecting a second, differently oriented FM antenna.

A pair of convenience a.c. outlets, the usual spring-loaded speaker terminals, an AM channel-spacing switch (9 kHz for European use, 10 kHz for the U.S.), and terminals labelled "Synchro" (for use with other JVC components that have CompuLink circuitry) complete the rear-panel layout.

Tuner Measurements

Figure 1 shows how FM signal-to-noise ratio and distortion vary as a function of incoming signal levels at the antenna terminals. Usable sensitivity in mono measured 10.0 dBf, marginally better than claimed. Stereo usable sensitivity was a function of the stereo threshold and muting setting, which, in the sample I tested, was set at around 28 dBf. For 50-dB quieting, I measured a very low 13 dBf in mono and 37 dBf in stereo, both better than claimed. Best S/N ratios in both mono and stereo fell a bit short of JVC's specs but were still very respectable for a receiver of this type, measuring 82 and 76 dB, respectively. Harmonic distortion in mono FM for a 100%-modulated, 1-kHz signal was 0.08%, exactly as claimed, but in stereo the THD was a low 0.06%, as against the spec of 0.08%.

Figure 2 shows how FM THD varied with modulating frequencies. At 100 Hz, THD was 0.07% in mono and 0.09% in stereo; at 6 kHz (the other test frequency established by the EIA's Standard), THD was 0.18% in mono and 0.20% in stereo. These results compare favorably with those obtained for some of the best separate tuners I have measured.

Figure 3 is a spectrum-analyzer plot of FM frequency response and stereo separation. Response was flat from 30 Hz to 15 kHz, with maximum deviation from perfectly uniform response reaching −0.4 dB at 30 Hz and −0.6 dB at 15 kHz. When you consider that this unit's 19-kHz rejection was nearly 70 dB, you can appreciate what a job it was to design an FM audio output circuit that remains nearly perfectly flat in response all the way up to 15 kHz. All but a very few tuners I have measured exhibit a loss in response of anywhere from 1.0 to 3.0 dB at this frequency. Stereo separation, the lower trace in Fig. 3, was excellent. At the three required test frequencies of 100 Hz, 1 kHz, and 10 kHz, stereo separation measured 45, 52, and 41 dB, respectively. Figure 4 compares the output from a channel 100% modulated by a 5-kHz signal (tall spike at left of the 'scope photo) to that of the unmodulated opposite channel (shorter spike within the tall one). The few spurious components farther to the right in the photo represent crosstalk at the unmodulated channel's output, and consist primarily of harmonic distortion and very low-amplitude 19- and 38-kHz

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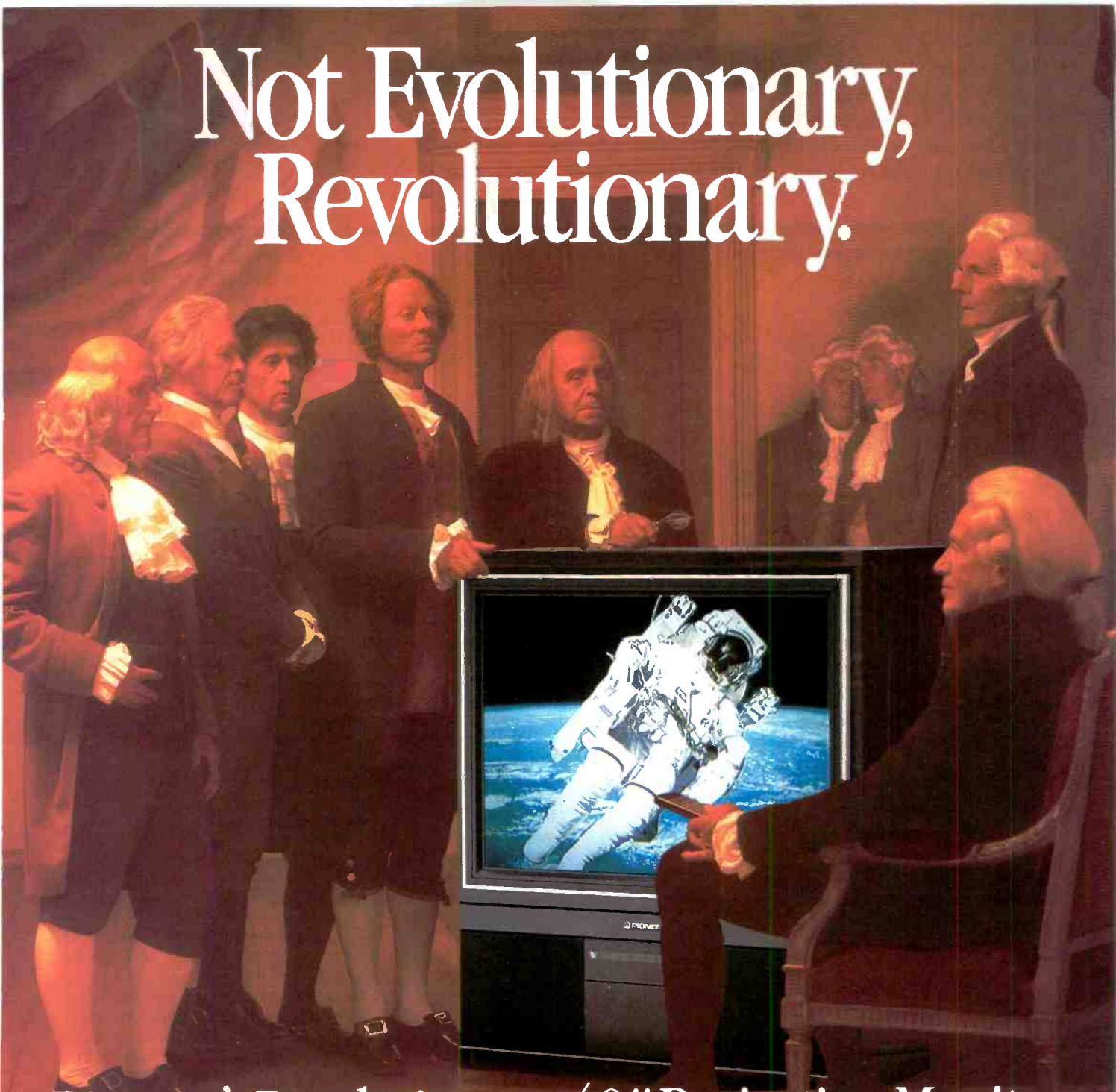

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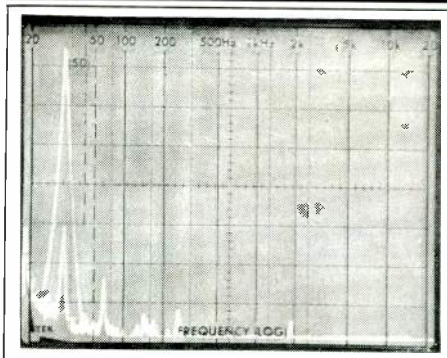

Fig. 4—Separation and crosstalk components for a 5-kHz FM modulating signal.

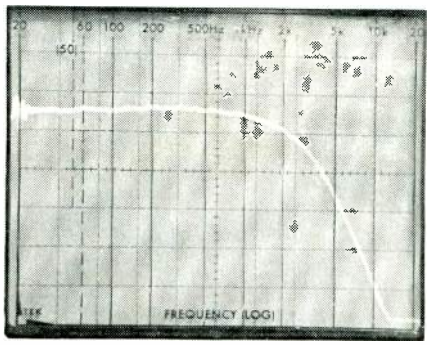

Fig. 5—AM frequency response.

components. The horizontal sweep in Fig. 4 is linear and extends from 0 Hz to 50 kHz, and the vertical scale is 10 dB per division.

Capture ratio measured 1.5 dB, using a 45-dBf signal as a reference. Alternate-channel selectivity was 72 dB. Image, i.f., and SCA rejection measured 90 dB, greater than 100 dB, and 65 dB, respectively. Muting level was the same as stereo threshold, 28 dBf. To receive signals less powerful than that, you must press the button which simultaneously defeats the muting and puts the tuner into mono mode. The reasoning here is that you wouldn't want stereo at such low signal levels because of the added background noise. Incidentally, while it was difficult to "push" the tuner into its special Quieting Slope Control mode deliberately, the tuner did go into this mode when I used generated test signals during some of my listening tests. I was able to detect a decrease in separation and an attendant decrease in background noise when the QSC feature was active.

Figure 5 is a plot of frequency response for the RX-9V's AM tuner section. The sweep in this 'scope photo is logarithmic and extends from 20 Hz to 20 kHz. As you can see, response is about as disappointing as it is in the AM circuits of most high-fidelity tuners and receivers. The −6 dB point was reached at a frequency of about 2.8 kHz.

Amplifier Measurements

The power-amplifier section delivered its claimed 120 watts per channel of continuous power at its rated distortion of 0.007% at mid-frequencies. At the frequency extremes, however, THD rose a bit beyond the rated level, to 0.009% at 20 Hz and 0.015% at 20 kHz. Figure 6 is a "three-dimensional" plot of THD versus frequency and power output into an 8-ohm load. While the levels of THD are hardly worth getting upset about, JVC might well consider being a little more conservative in their published THD rating, lest they arouse the ire of the FTC.

What proved disappointing was the amplifier section's performance when driving 4-ohm loads. The receiver's current-limited power supply was able to deliver a maximum of only 80 watts per channel; at that, THD was considerably higher than it was for this power level when driving 8-ohm loads. At 50 watts per channel into a 4-ohm load, THD at mid-frequencies was back to its low levels of around 0.007% to 0.009%. It is not surprising, in view of the performance at lower output impedances, that JVC chose not to provide a standard 4-ohm power rating for this receiver.

Damping factor, measured with a test frequency of 50 Hz and referred to 8-ohm loads, was 71.5. Dynamic headroom was a moderate 1.0 dB, again with 8-ohm loads.

One of the most outstanding features of the RX-9V's preamplifier/control section is its seven-band equalizer/analyzer. The five factory-assigned response curves in the graphic equalizer's memory circuits are very much suited to their suggested applications. But if you don't like those curves, you can create your own and assign them to additional memory locations for future use. Figure 7 shows the maximum boost and cut range of each of the seven equalizer bands. If you are against tone controls of any sort, it's equally easy to bypass the whole arrangement and restore totally flat response at the touch of a button. Figure 8 shows the typical bass and treble compensation afforded by the loudness-control circuit incorporated in the RX-9V.

Input sensitivity for the moving-magnet phono section, referred to 1 watt output, measured 0.24 mV. For the moving-coil inputs, 0.02 mV was required at the input terminal to produce 1 watt of output at 1 kHz. Frequency response for the phono section was accurate to within +0.6 and −0.4 dB of the RIAA playback curve from 20 Hz to 15 kHz. Phono overload at the MM inputs occurred with a 1-kHz signal of 100-mV amplitude; for the MC inputs, overload was 20 mV. Input sensitivity for the high-level inputs measured 22 mV for 1 watt output. Frequency response for the high-level inputs

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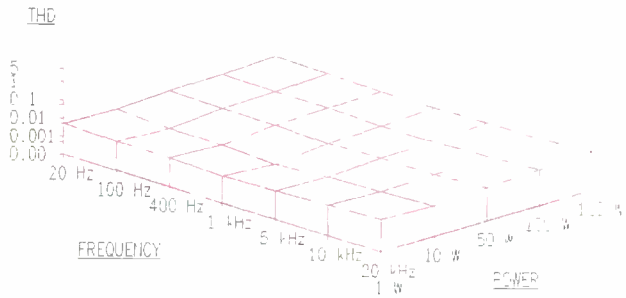

Fig. 6—THD vs. frequency for five power levels with an 8-ohm load.

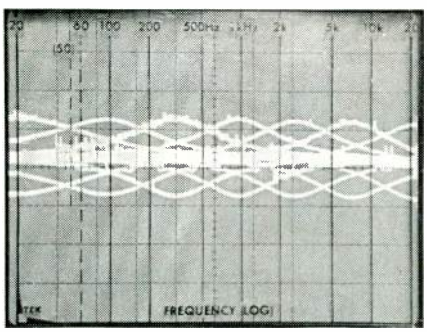

Fig. 7—Equalizer control range.

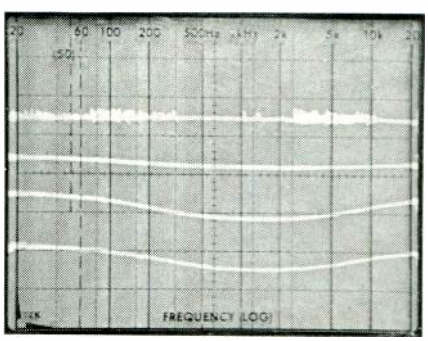

Fig. 8—Loudness-control characteristics at various volume settings.

(both audio-only and video-related) was flat within 1.0 dB from 8 Hz to 40 kHz and within 3 dB from 4 Hz to 75 kHz.

Signal-to-noise ratio for the MM phono inputs, referred to 1 watt output and with 5 mV of a 1-kHz signal applied to the inputs, measured an impressively high 83 dB (as against 80 dB claimed). For the MC inputs, using a 0.5-mV input and adjusting the volume control to produce a 1-watt output into 8-ohm loads, S/N was 70 dB. For the high-level inputs, again referred to 1 watt output but with a 0.5-V signal applied, S/N measured 80 dB, while at minimum volume settings, S/N measured 87 dB below 1 watt output. Translated to rated output, this would be an S/N ratio of greater than 107 dB.

Use and Listening Tests

Even though this receiver didn't deliver as much power as I would have expected at 4 ohms, I was pleased to find that it was able to drive my reference speakers (which look more like 4 ohms than like 8 at most frequencies) to lifelike sound levels and even a bit beyond. The FM tuner performance was excellent. As I mentioned earlier, on the few weak stereo signals that were nevertheless strong enough to overcome the muting/stereo threshold, the QSC circuit worked well, retaining adequate stereo separation while at the same time reducing background noise and distortion significantly. I have the feeling that this circuit is more than just a simple "blend" type, since it seemed to counter the effects of multipath more than I would have expected from such a circuit. However, since I wasn't given a schematic of the RX-9V and since relatively little detail concerning this circuit is provided in the owner's manual, I'm only guessing about that.

I found the front-panel displays to be extremely helpful in sorting out the many options and signal flow paths that are available. While I like to think of myself as an independent spirit when it comes to tone-control settings, I must confess that I called up the equalizer's preset response curves more than once during my listening tests. They really do help with certain kinds of music. At other times I couldn't help but switch the display to its alternate function of real-time spectrum analyzer. When I think of how much I spent for a seven-band spectrum analyzer—in the form of a portable test instrument—some years ago, I am amazed that JVC was able to incorporate such a feature in a receiver that sells for less than my test instrument originally cost.

Audio signals, including phono and CD, were in no way degraded by passing through this receiver. Video signals were also handled with what seemed to me to be little or no degradation. In that respect, however, this unit acts only as a sort of control center or switchboard, unlike some other A/V receivers now available that allow you to do some video-signal processing as well.

Especially in view of the rising value of the Japanese yen, at its suggested retail price of $720, the JVC RX-9V is a remarkably designed and executed product. If you're planning to assemble an integrated audio/video system or simply to add some video components to your current stereo system, I can't think of a more appropriate unifying product to serve as such a system's central element.

Leonard Feldman

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3

THORENS TD 320 TURNTABLE AND TP 16 MK III TONEARM

Manufacturer's Specifications

Turntable

Drive System: Belt.

Motor: Low-voltage, 16-pole synchronous, with two-phase electronic speed control.

Speeds: 33⅓ and 45 rpm.

Platter: 12-in. (30-cm) diameter, dynamically balanced, zinc alloy, 6.8 lbs. (3.1 kg).

Wow and Flutter: 0.035%, per DIN 45-507.

Rumble: Unweighted, 52 dB (DIN 45-539), 64 dB measured with Thorens *Rumpelmesskoppler*; weighted, 72 dB (DIN 45-539), 80 dB with *Rumpelmesskoppler*.

Power Requirements: 17 V a.c., 140 mA, from external transformer (supplied); rated total power consumption, 5 watts.

Tonearm

Effective Length: 9⅛ in. (23.2 cm).

Effective Mass: 7.5 grams.

Stylus Overhang: 16.4 mm, adjustable.

Offset Angle: 23°.

Lateral Tracking Error: 0.18°/cm.

Anti-Skating: Magnetic.

Bearing Friction: 0.15 mN in both planes.

Capacitance: 100 pF, including cable.

Headshell: TP 63 plug-in wand.

Cartridge Weight Range: 3 to 8.5 grams with standard counterweight; up to 12 grams with optional counterweight.

General Specifications

Dimensions: With cover closed, 17⁹⁄₁₆ in. W × 13¾ in. D × 6⁷⁄₁₆ in. H (44 cm × 35 cm × 17 cm); with cover open, 17½ in. D × 16¹⁵⁄₁₆ in. H (44.5 cm × 43 cm).

Weight: 24.2 lbs. (11 kg).

Price: $529; optional counterweight, $10; extra arm wand, $25.

Company Address: Epicure Products, 25 Hale St., Newburyport, Mass. 01950.

For literature, circle No. 92

Thorens, now of Wettingen, West Germany, has been manufacturing precision record-playing equipment since the turn of the century, and their products have long been favorites of many audiophiles. The TD 320 is a semi-automatic belt-driven machine that falls, pricewise, in the middle of their current line.

The TD 320 is a large and solid turntable that weighs in at just over 24 pounds. The 6.8-pound platter is made of a zinc alloy, and the base is constructed of an acoustically deadening wood material that is said to suppress any resonances that might spoil the reproduced sound. The motor is a low-voltage, 16-pole synchronous type; a separate step-down transformer is provided for the 120-V U.S. standard, and transformers for other voltages are available. Speed selection is electronic.

The Thorens has only three controls on its base: A motor start button, a speed-selection and stop switch, and a tonearm-cueing lever. To play a record, you place the stylus above the first groove, select the proper speed, press the start button, and manually lower the stylus to the record with the cueing device. At the end of each record, the tonearm automatically lifts up and the motor turns itself off. As a safety precaution, the cueing device locks the arm in the up position when the platter is turned off. After years of using completely manual turntables, it took me just a few minutes to become pleasantly reacquainted with the Thorens' automatic convenience and safety features.

The turntable comes with the Thorens TP 16 tonearm. The Mk III version of this arm, which we tested, uses the Thorens TP 63 cartridge wand, a headshell permanently mounted to a short armtube that plugs into the main arm assembly close to the pivot. Cartridge mounting is via standard, half-inch spacing. The counterweight supplied is recommended for use with cartridges weighing from 3 to 8.5 grams; heavier counterweights for heavier cartridges are available as optional accessories.

The arm is dynamically balanced, with tracking force supplied by a spring. After the arm's counterweight is balanced for a particular cartridge, a knob on top of the pivot assembly is turned until a dial indicates the proper downward force.

The anti-skating compensation is magnetic, adjusted by turning the control located on the right side of the tonearm. There are calibrated scales on the anti-skating device for spherical or elliptical stylus shapes, and for dry or wet record surfaces.

A plastic gauge is supplied for setting the proper stylus overhang and stylus tracking angle. The TP 16 Mk III has no height adjustment at the pivot, so five plastic spacers are provided for placement between the cartridge and headshell for stylus angle adjustment.

(*Editor's Note*: As this review went to press, Epicure announced that the TD 320 is now being supplied with the TP 16 Mk IV arm, which has a nondetachable armtube. For convenience in cartridge mounting, the new arm's headshell can be unlocked and turned upside down. According to Thorens, the Mk IV's fixed armtube is more rigid than the detachable armtube of the Mk III, because the joint between the wand and the pivot assembly is eliminated. The new arm also has a higher effective mass, 12.5 grams, which should

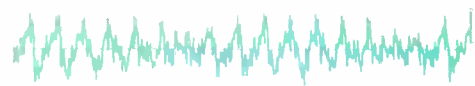

Fig. 1—Wow and flutter, DIN unweighted peak, over a 32-S period.

Fig. 2—Wow and flutter, DIN weighted peak, over a 32-S period.

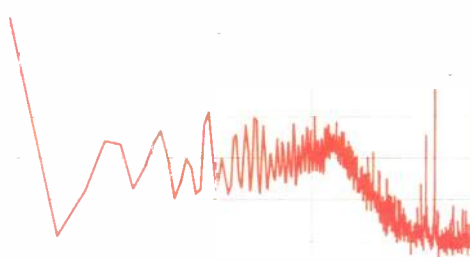

Fig. 3—Spectrum of wow and flutter from 0.125 to 100 Hz re: 5.0 cm/S at 3.15 kHz.

After years of using manual turntables, it's pleasant to reacquaint myself with automation's convenience and safety.

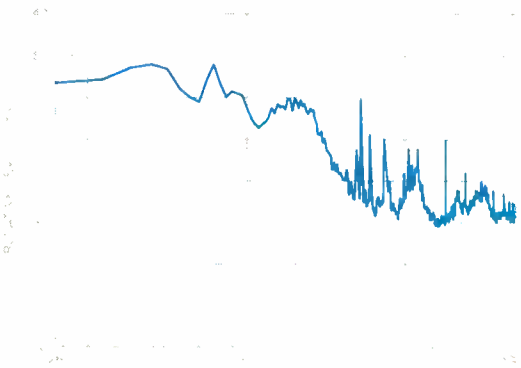

Fig. 4—Rumble spectrum; 0 dB equals 5.0 cm/S.

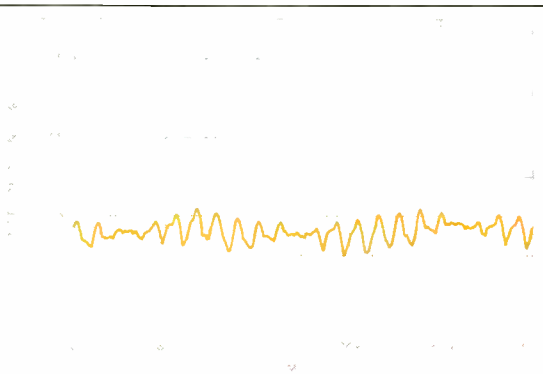

Fig. 5—Speed drift over a 41-S period.

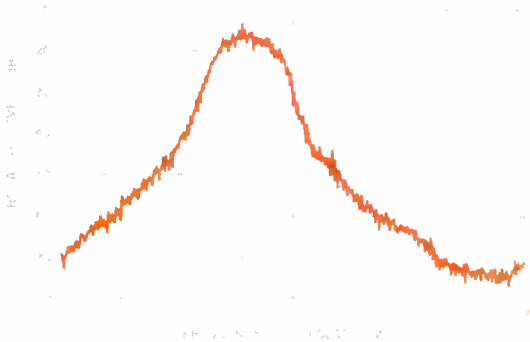

Fig. 6—Speed stability, referenced to 3.15-kHz tone and where 0 dB equals 3.54 cm/S.

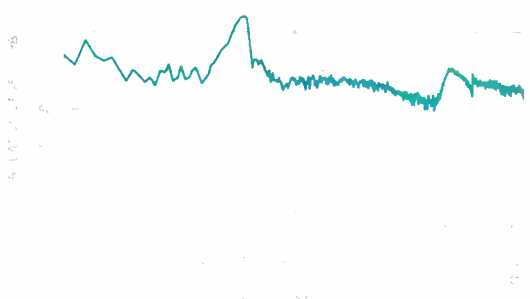

Fig. 7—Suspension resonances from 1 to 100 Hz. The major resonance is at 6.12 Hz. See text.

make it a better match for moving-coil and other cartridges of moderate compliance. The Mk IV arm has the same pivot bearings and the same tracking-force and anti-skating systems as the Mk III. The turntable is also available without an arm, as the TD 32*, for $409.)

Measurements

All measurements were conducted at the CBS Technology Center in Stamford, Connecticut, with a Shure ML140HE cartridge used for the testing. The cartridge features the Shure Dynamic Stabilizer, a combination brush and damping system which helps keep the cartridge stable and the stylus in the groove, and which helps track warped records. The Stabilizer was in use during these tests.

Wow and flutter was measured as ±0.13% unweighted peak (Fig. 1) and ±0.08% DIN weighted peak (Fig. 2). Figure 3 plots the spectrum of the measurements by taking the magnitude of the Fourier transform of the flutter output from a wow and flutter meter. Rumble was measured as −43 dB unweighted and −76 dB weighted, using an unmodulated record groove referenced to a 315-Hz test tone. The rumble spectrum is shown in Fig. 4. Turntable speed was accurate, with the TD 320 running 0.2% slow at 33⅓ rpm and 1.2% slow at 45 rpm. Speed drift as measured over time (Fig. 5) was negligible. Speed stability is shown in Fig. 6. The test for suspension resonance (Fig. 7), measured by taking the transfer function between a force applied to the turntable platter and an accelerometer mounted on the platter, shows the primary resonance occurring at 6.12 Hz. This is close to record warp wow frequencies, which are most frequently in the range from about 4 to 6 Hz.

Figures 8 and 9 show the response to a mechanical shock applied to the platform upon which the TD 320 was resting. Figure 8 shows the output of an accelerometer when the platform was vertically struck with a hammer close to the turntable base; Fig. 9 shows the output of the cartridge caused by the same hammer strike. A frequency spectrum of the output caused by that same hammer strike (Fig. 10), as well as measurements taken when the platform was struck in and along the horizontal plane of the turntable, show the turntable/cartridge combination able to achieve very good mechanical shock isolation.

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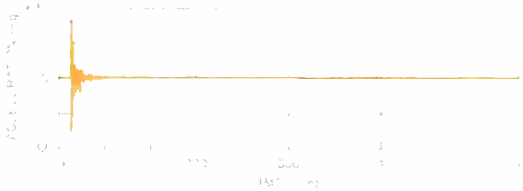

Fig. 8—Accelerometer output vs. time for a vertical shock applied to the turntable base.

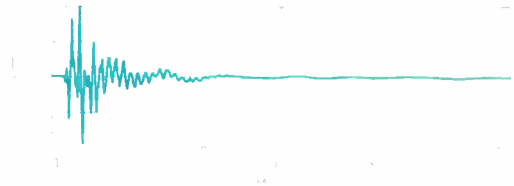

Fig. 9—Cartridge output vs. time for the vertical shock of Fig. 8.

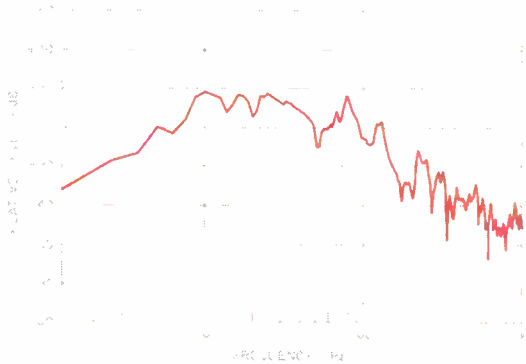

Fig. 10—Spectrum (to 1 kHz) of output from impulse of Fig. 8, where 0 dB equals 1 cm/S per 1 g.

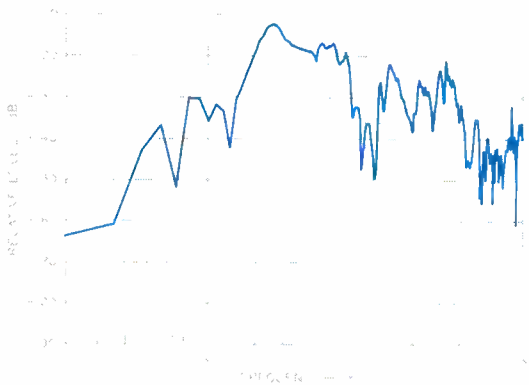

Fig. 11—Isolation from airborne sound is indicated by this spectrum (to 1 kHz) of vibrations from a 100-dB SPL acoustic field near the record surface, with stylus resting in a groove. Reference level (0 dB) is 1 cm/S per 1 dB SPL.

The CBS Technology Center also measured isolation from airborne sound. Figure 11 shows the difference between the output of a microphone placed near the platter and the cartridge output with the stylus resting in a groove and a 100-dB SPL acoustic noise signal applied near the platter surface.

The TP 16 Mk III's stylus tracking-force adjustment was checked against a separate gauge and found to be quite accurate.

Use and Listening Tests

Setup of the Thorens is fairly straightforward and simple, even for beginners. The instruction manual is easy to understand and follow. The only adjustment I would have liked to change was that for the stylus vertical tracking angle. Separate tonearms allow you to change this angle by altering the height of the tonearm itself at the pivot point. This integrated tonearm has no pivot height adjustment; all height adjustments are made at the headshell. When mounting a cartridge, you must guess which spacer or combination of spacers must be used to obtain the proper height. If you're mistaken, the cartridge has to be demounted and the process started again, a time-consuming and often frustrating task. In defense of this system, the cartridge height will remain correct once adjusted, even after changing tonearm wands. All other adjustments on the TD 320 are simple, and this is one of the few tonearms I've worked with recently whose lift mechanism needed no adjustment in order to work properly.

Once set up, the Thorens TD 320 provided a large degree of enjoyment in my listening room. I used many cartridges in my evaluation, but the Shure ML140HE was deemed typical of what might be matched to the Thorens in a home setup. On all types of music, this playback system gave a fine accounting of itself, providing rock-solid imaging, smooth midrange, and flat, extended highs. Deep bass from the Thorens was not as good as from my reference system. On the other hand, due to the TD 320's excellent isolation, at no time did I hear any acoustic feedback, even when listening at high volume levels and despite the turntable's close proximity to my loudspeakers.

As a medium-priced turntable and arm combination, the Thorens TD 320 provides proof that the black vinyl disc can still provide a measure of high-fidelity reproduction in the home, and that LPs haven't yet been killed off by CDs.

Gary Krakow

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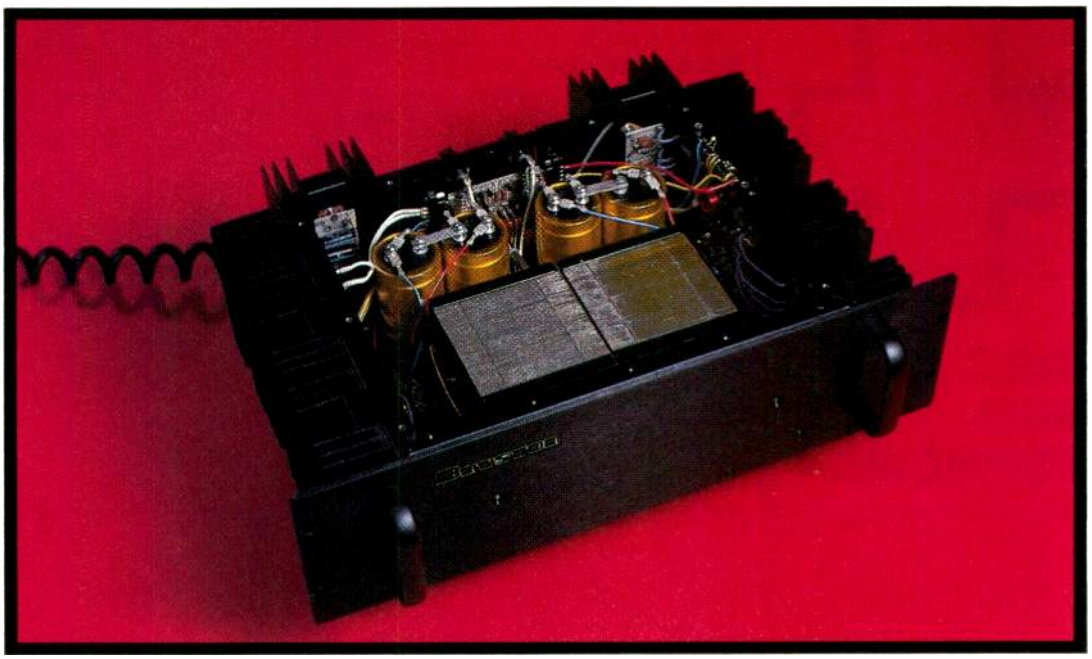

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2. Long term reliability
3. Product integrity

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4

SPEIDEN SF-12 STEREO MICROPHONE

Manufacturer's Specifications
Frequency Response: 30 Hz to 15 kHz, ±3 dB.
EIA Sensitivity: 1.4 mV/Pa.
Impedance: 200 ohms.
Dimensions: 1 in. diameter × 8 in. L (2.54 cm × 20.32 cm).
Weight: 12 oz. (0.34 kg).
Supplied Accessories: Shure A55M cushion mount with 5/8-27 thread; cable terminating in twin three-pin XLR-type male connectors.
Price: $800.
Company Address: 1216 Denmark Rd., Plainfield, N.J. 07062.
For literature, circle No. 93

The Speiden SF-12 is a one-point stereo microphone consisting of two stacked ribbon transducers in a cylindrical case, with the pickup axes fixed at 90°. The ribbon units are open to the atmosphere on both sides and therefore respond to the difference in sound pressure between the two sides. This pressure gradient corresponds to the particle velocity of the air; hence, transducers of this type are called velocity microphones. The ribbon velocity microphone was patented in 1931 by H. F. Olson, and those made by RCA were widely used in radio broadcasting for 30 years thereafter. (L. J. Anderson was responsible for the practical design of RCA's ribbon mikes from 1929 to 1960, at which time I myself assumed those duties.)

Ribbon velocity microphones are noted for having figure-eight, bidirectional, cosine patterns which are quite independent of frequency in the horizontal plane; this is because ribbon widths are small compared to the wavelength of sound. In the vertical plane, the pattern sharpens at high frequencies because the ribbon is long compared to its width. Olson found that this is a minor problem for pickup of musical performances, because the sources in such cases are in a horizontal plane. The frequency response of a (properly designed) velocity microphone is uniform above the resonance, which is placed at the lowest frequency consistent with mechanical stability of the ribbon.

The twin elements of the SF-12 are arranged so that the pickup axes are perpendicular. With vertical mounting, the top element feeds the left channel and the bottom one feeds

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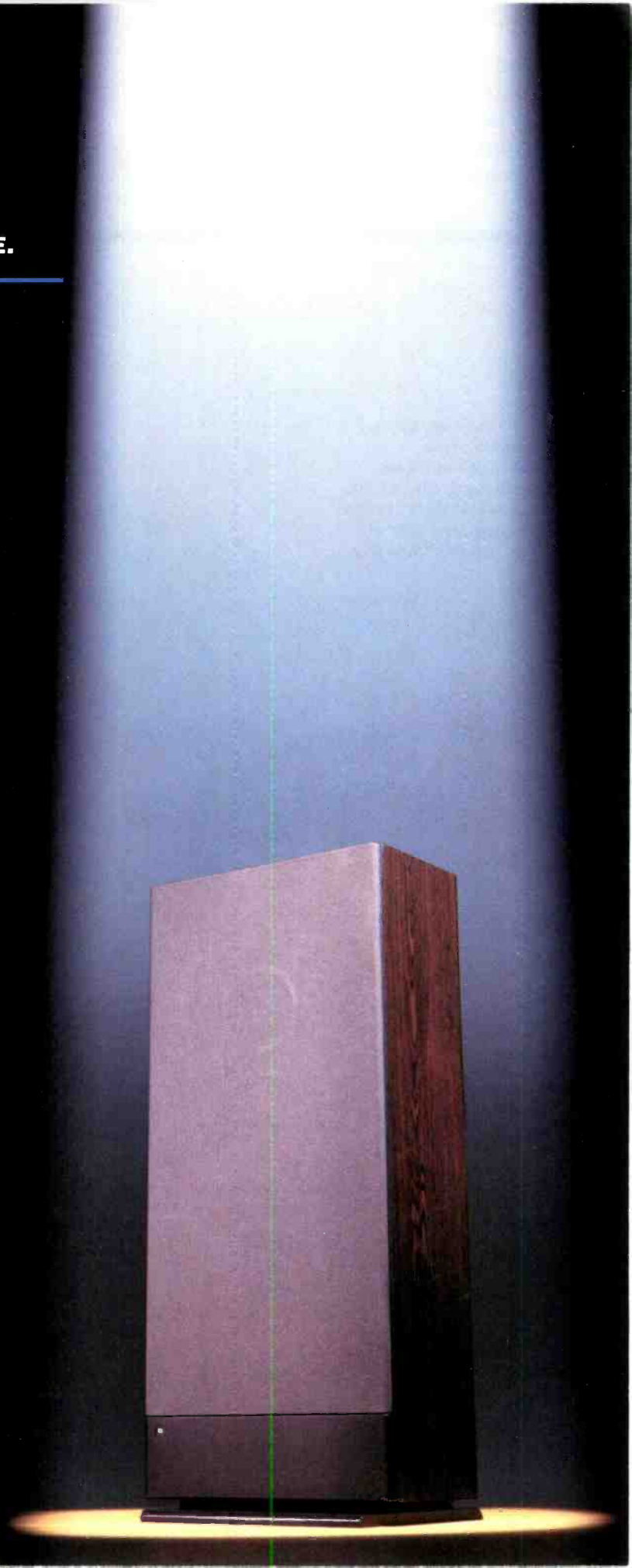

Ribbon velocity mikes are noted for figure-eight patterns that are quite independent of frequency in the horizontal plane.

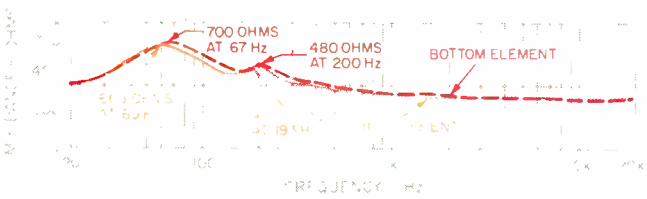

Fig. 1—Impedance vs. frequency. The resonances at 60 Hz (top element) and 67 Hz (bottom element) should shift lower and smooth out as the mike ages.

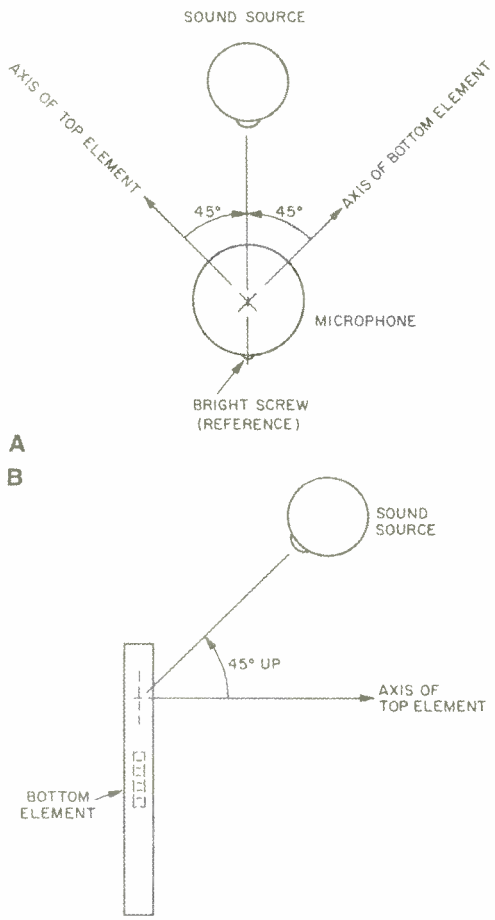

Fig. 2—Geometry for directional tests of frequency response. Note that sound sources on the microphone's axis are 45° off-axis for both the top element (A) and the bottom (B).

the right. The configuration is similar to the B & O stereo mike which was popular in the early days of stereo, except that the angle between the elements of the B & O was adjustable, and it had bass-cut and interelement phasing switches in the lower part of its case. I recently had the opportunity to check a 20-year-old B & O and found that these adjustments had become unreliable. Thus, I prefer the SF-12, with its fixed settings.

According to the literature furnished by the manufacturer, the SF-12 may be used for X-Y stereo or M-S stereo, the latter requiring a matrix network to retrieve the left and right audio channels. The X-Y arrangement of twin figure-eights at 90° is referred to as a Blumlein array, after the inventor who was experimenting with stereo at the same time as Olson was working on ribbon microphones. This early work has prompted Speiden to use the slogan "a brand-new idea from 1931!" on the catalog sheet. (The interested reader may refer to the July/August 1985 issue of the *Journal of the Audio Engineering Society* for articles by me, Wes Dooley, and Ron Streicher which describe velocity and coincident stereo microphones as well as how to use them.)

The SF-12 is recommended for one-point pickup of entire orchestras or groups of instruments. It should not be used for close-miking because of the bizarre imagery that could result. Another reason is that velocity microphones have a large proximity effect, resulting in exaggerated bass when used close to a source. Velocity mikes must have low-cut equalizers if used close, and the SF-12 has none.

The SF-12 was developed and is being manufactured in limited quantities by Bob Speiden, who operates a recording studio when he isn't making microphones. He patterned the SF-12 after the B & O, eliminating what he judged to be unreliable features and using high-tech materials. I think he has succeeded in converting a consumer microphone design into a professional-quality product. I do advise the reader, however, that the Speiden production and test facilities are limited, and they may not be able to handle a sudden, big demand for product or maintenance.

Measurements

Testing a ribbon mike's impedance is the best check on its quality. The resonant frequency and impedance must remain stable when the ribbon is displaced by breath puffs against its edge; failing this test indicates that the element is twisted or is dragging against the gap.

The first SF-12 I tested had one dragging ribbon, which was caused by its resonant frequency being set too low. The second unit I tested, however, had resonant frequencies between 60 and 70 Hz, as specified (Fig. 1). Speiden is using RCA-type ribbons, which have only transverse corrugations, and such ribbons loosen with aging. (A ribbon design with longitudinal corrugations in the middle and transverse corrugations at the ends, which I believe to be more stable, is used by Beyer.) The SF-12's short ribbon is similar to that of the RCA 77-DX. Experience indicates that its resonance may drift down to the 50-Hz region after a few months, and remain there for many years of dependable operation. The sample mike's impedance curves, shown in Fig. 1, are tolerably well matched and very similiar to that of the 77-DX. (A caution to home testers: Resistance testing

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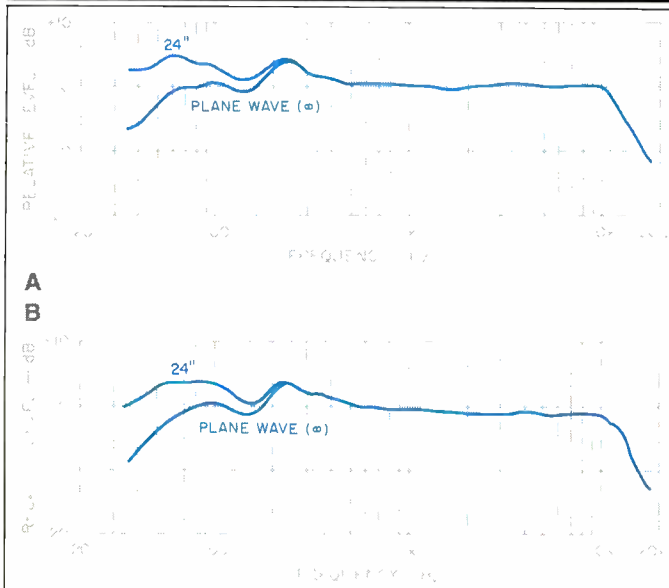

Fig. 3—Axial frequency response of top (A) and bottom (B) elements for plane waves and for sources 24 inches from the microphone. (0 dB = −59.5 dBV/Pa)

with an ohmmeter is a major cause of ribbon failure. I test with a very low, constant a.c. current, as described in the April 1977 issue of *Audio*.)

I also must add a note about ribbon soldering: The old RCA ribbons were soldered, and Beyer does this also. Bob Speiden, however, feels that he has selected compatible materials for the clamps and prefers not to solder. Past experience shows that unsoldered ribbon circuits may open over time. Of course, this is not a major problem to repair.

Figure 2 illustrates the geometry involved in acoustical response testing. It is important to note that the bright plated screw (Fig. 2A) defines the back of the microphone, which is opposite the sound source. If the microphone is turned 90°, the outputs will be out of phase.

Figure 3 shows the axial responses of the two elements. (Referring to Fig. 2, note that sounds on either element's axis are 45° from the direction in which the microphone is pointing.) The curves are well matched, within 1 or 2 dB. The first thing evident is that the responses roll off above a −3 dB point of about 13 kHz. This is related to the path length from the front to the back of the ribbon. If the path length were shortened, the cutoff frequency would rise, but the pressure difference and the output level would decrease. Such a decrease would reduce dynamic range, at least with some mixers, due to preamp noise. Note that, thanks to Speiden's use of the most efficient magnets available, the SF-12's measured output level was −59.5 dBV/Pa. This is very close to the low limit of −60 dBV/Pa for 250-ohm electrodynamic microphones established in my *JAES* article. I believe the SF-12 to be a state-of-the-art design.

The high-frequency cutoff is a bit lower than the specified 15 kHz. I do not criticize the manufacturer for this, because microphone calibration above 10 kHz is difficult, particularly when one has to compare a ribbon velocity mike to a lab-standard condenser mike. I found the old B & O had a cutoff of 11 kHz, so the SF-12 represents an improvement. Also, some readers may remember my August 1980 "Equipment Profile" of the Shure SM-81, a high-quality condenser mike. Although the Shure's axial response cutoff was shown to be about 16 kHz, the cutoff at 90° was about 11 kHz. In contrast (Fig. 4), the SF-12 maintains at least a 13-kHz cutoff throughout its useful horizontal pickup angle, broadening slightly at 45°. At 90°, where a near-ideal null of about 20 dB is maintained, the cutoff frequency is still the same. The Shure condenser mike, at 180°, did not maintain a uniform null; the curve varied over a 12-dB range. I am willing to trade off a little axial response to gain flatter off-axis response. This is especially important in X-Y stereo pickup, where there is no mike aimed straight at the centrally located performers.

Figure 5 shows that, in the vertical plane, the off-axis responses are less uniform, but not extremely so. I would recommend that you take care to position the SF-12 so that all sources are within about 20° of the axis, vertically.

Figures 3 shows low-frequency responses measured at 24 inches, and the (calculated) plane-wave curves. The response obtained in actual use will probably lie between these curves; I have found that velocity mikes with a bass roll-off for plane waves can make quite good recordings of a pipe organ. The "lump" at 250 Hz is related to the overtone of the ribbon resonance. I think the lump will smooth out and shift to a lower frequency with normal usage over time. The old B & O after 20 years had no lumps, and the bass roll-off for plane waves was scarcely evident. However, to keep the lumps within specifications during the break-in period, it might be wise for the manufacturer to add more acoustical-resistance damping.

The phasing of each unit was found to be standard and correct when the bright screw was oriented as shown in Fig. 2. Compared to a Beyer M500 ribbon mike, the SF-12 was very sensitive to wind, and I think a foam screen should be supplied for wind (and dirt) protection. Vibration sensitivity was found to be high; the top unit had a ringing sound at 390 Hz. Ribbon transducers have inherently low vibration sensitivity because of the low mass of the ribbon, but if they are mounted in a housing that "rings," the sound couples acoustically to the ribbon. This can be remedied by applying damping material to the housing. The furnished cushion mount provides adequate isolation. Magnetic hum pickup was very low—as low as the Beyer.

My last test was to measure the frequency response of each channel compared to that obtained with the outputs mixed one-to-one. This was conducted with the bright screw oriented away from the source. The sum curve resembled the curves for the individual units quite well, except it was 6 dB higher in level. Therefore, it would seem the units are phase matched.

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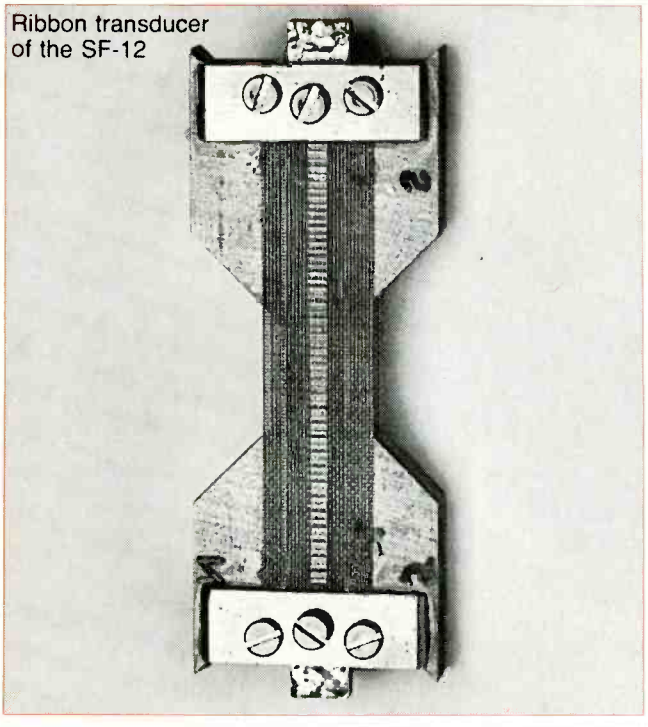
I was very pleased with the transparent sound and accurate perspectives of tapes made with the SF-12.


Ribbon transducer of the SF-12

Use and Listening Tests

I used the SF-12 first as a backup mike to record a Christmas Eve church service on a Revox A77 open-reel tape deck. The reference recording was made on an Aiwa F990 cassette deck with Dolby C NR and HX-Pro, driven by an AKG C-422 stereo microphone set for Blumlein stereo. (Please note that the C-422 costs $2,650!) While the AKG was flown 20 feet overhead, the Speiden had to be mounted on a floor stand. I used the Shure S-15 stand, which can elevate a mike to 15 feet and is great as a substitute for "flying." Though the AKG is not a low-output mike, I didn't drive the Aiwa's mike inputs directly; the Aiwa has a higher input impedance and lower voltage gain than other recorders I use. I had to use a pair of Jensen transformers with a 200-to-600 ohm step-up. These were mounted in a steel box with XLR-type connectors plus the switches which Jensen recommends to provide a choice of grounding protocols.

For evaluation, all tapes were played into my modified, matched, and equalized Altec 604C studio monitor speakers, in a listening room that closely resembles what is recommended by the IEC. On the church recording, making an effort to ignore the different auditory perspectives, I found that the SF-12 sounded very similar to the C-422. A variety of sound sources was recorded: A brass quintet, a cello, a bell choir, a pipe organ at maximum power output, a choir and soloists, and 1,000 people singing. I concluded

COUNTERPOINT: A CLASSIC MIKE

The Speiden SF-12 was used to record a concert by the Princeton Pro Musica in Richardson Auditorium at Princeton University. The program consisted of works for a cappella choir, Schubert's Fifth Symphony, and Beethoven's "Mass in C" with full orchestra, chorus, and four soloists.

Both as a recording engineer and as an amateur choir singer, I have been frustrated for some time in trying to find the right microphone to record the human voice, especially the unique, massed sound of a large choir. The frequency response characteristics of even the best condenser mikes, to my ears, add an unnatural edge to the vocal sound and tend to exaggerate such consonants as "t" and "s." While this type of sound has come to be commercially acceptable, I have never been quite satisfied with it. The SF-12 had none of these problems. The sound of the choir was very smooth and natural, but at the same time there was no apparent loss of highs in the sounds of the violins or trumpets.

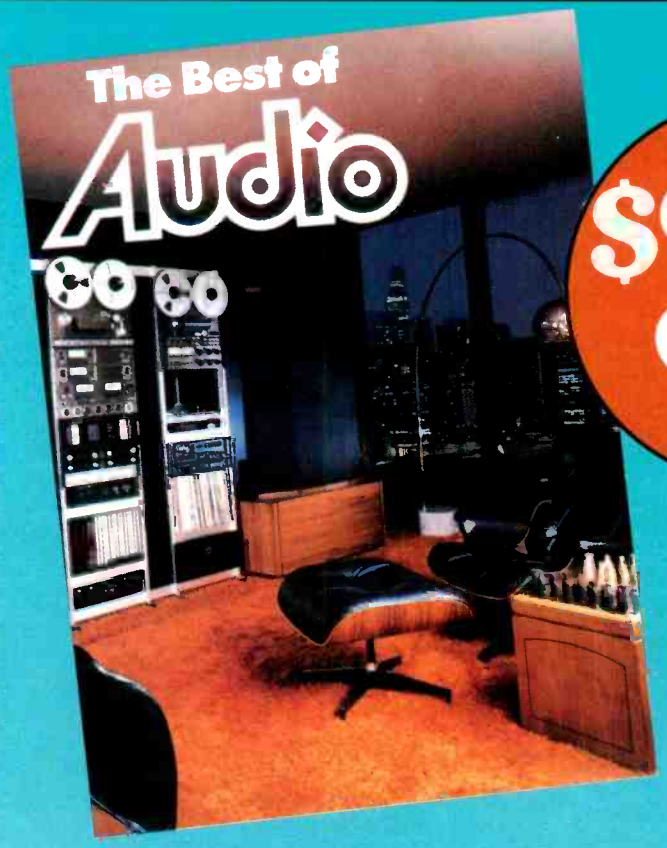
It is often difficult to place a Blumlein (crossed figure-eight) mike like the Speiden SF-12 so as to achieve proper balance between direct sound from the musicians and reverberant sound from the concert hall. If the microphone is placed too close to the stage, the resulting sound can be too dry; too far from the stage, and you lose presence and definition. The best solution is to have a good hall. As luck would have it, this was the case at Richardson Auditorium. The hall (which accommodates approximately 800 people) has a high, vaulted ceiling and curved walls interspersed with tall Greek columns; this results in a smooth reverberation time of about 2.5 S.

The SF-12 was placed 16 feet above the stage, about 3 feet behind the conductor. The mike was tilted downward by about 30° to improve stage presence and slightly reduce pickup of reverberant sound. The resulting balance in the Beethoven was virtually ideal, even though the choir was located behind the orchestra, more than 30 feet from the mike. Stereo placement was excellent, with the first violins firmly on the left, and cello and bass on the right along with the soloists. Despite the choir's distance from the mike, the vocal distribution could be easily perceived, with the sopranos on the left, altos on the right, tenors and basses in the center.

Unlike past ribbon-mike designs, the Speiden has quite a high output level, about the same as the average dynamic mike's. I had no problem using the SF-12 with my home open-reel deck. The recording was equal to anything I've heard made with the best professional equipment.

The SF-12 is the ideal microphone for the serious audio amateur or professional who wishes to use a minimum of mikes; for its price, it is a real bargain. Amazing as it may seem, the SF-12 is the only true Blumlein microphone made in the world today. Bob Speiden deserves our thanks for making this classic microphone design available again. *Charles P. Repka*

SOUND INSURANCE



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The SF-12 is an excellent portable substitute for the much more costly AKG, and I recommend it to all who own a quality recorder.

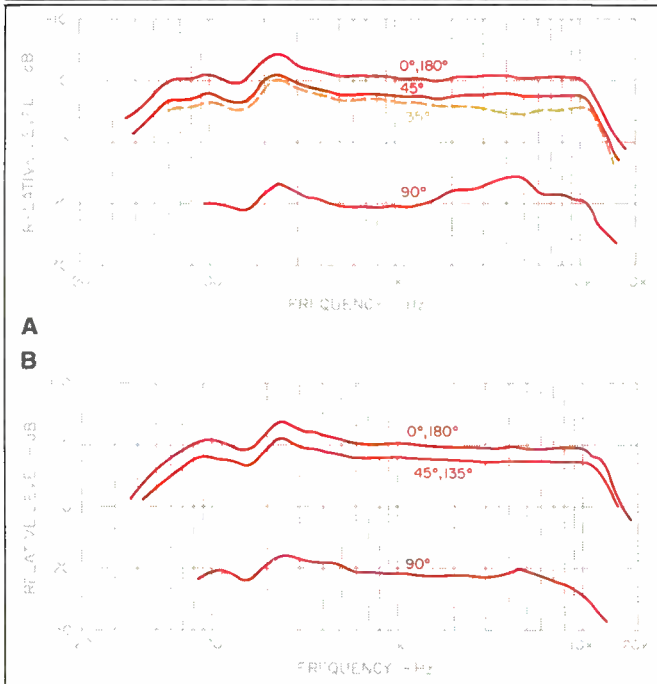

Fig. 4—Frequency response vs. horizontal angle for plane wave, for top (A) and bottom (B) elements.

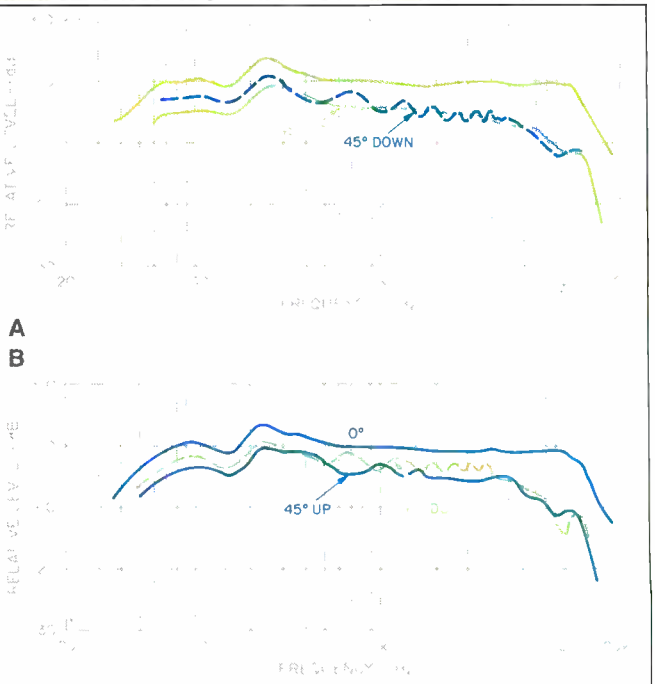

Fig. 5—Frequency response vs. vertical angle for plane wave, for top (A) and bottom (B) elements.

that the SF-12 would make a good substitute for the AKG in remote-location recordings, as this would avoid having to fly the mike and take it down again for a temporary setup. It would also be simpler to use properly than a pair of single-channel mikes.

One concert recorded with the Speiden was of a brand-new Yamaha grand piano accompanying solo trumpet and flute and assorted vocalists. The second was an operetta presented in concert form, with soloists arranged across the stage and accompanied by piano. The vocals ranged from bass to soprano. Cassette tapes were recorded on the Aiwa as above, again using the pair of Jensen transformers in driving the recorder's mike inputs. I was very pleased with the sound and the very accurate perspectives of both tapes made with the Speiden. Sound was quite transparent; there was no noticeable coloration due to the 250-Hz lump or the 13-kHz cutoff. (Actually, I do not hear well above 13 kHz!) In fact, I prefer the sound of these cassettes to any mass-produced LP or CD recording I've heard. Many commercial recordings are multi-miked; as a result, they have no real stereo perspective, especially when compared to recordings made with a single stereo microphone.

I have a word of caution about using the SF-12 or Blumlein arrays in general: The included angle of 90°, as compared to the 120° recommended for X-Y cardioids, means that the Blumlein should be farther from the sources to obtain similar perspectives and direct versus reverberant sound. I had difficulty in positioning the Speiden far enough from the performers, because the rear lobes picked up audience noise. In two cases, to reduce noise I had to select a compromise location, which resulted in slightly exaggerated perspectives and less room sound.

Conclusions

I find that in applications where figure-eight patterns are desired, the SF-12 is an excellent, comparatively low-cost, portable substitute for the C-422. It has the traditional ribbon advantage of "condenser quality" without the aggravations of powering and the possibilities for sputtering or failure in damp environments. I think it could serve as a music-recording mike for anyone with a cassette recorder who does not want to carry a mixer and several mikes and stands. For the audiophile, a stereo mike will offer a better chance of making a good tape in live situations where you can't experiment. I think the SF-12 would be great for live, on-site taping for the person who only wants to use two tracks and two mike inputs. I recommend the SF-12 to everyone who owns a quality cassette or open-reel recorder. *Jon R. Sank*

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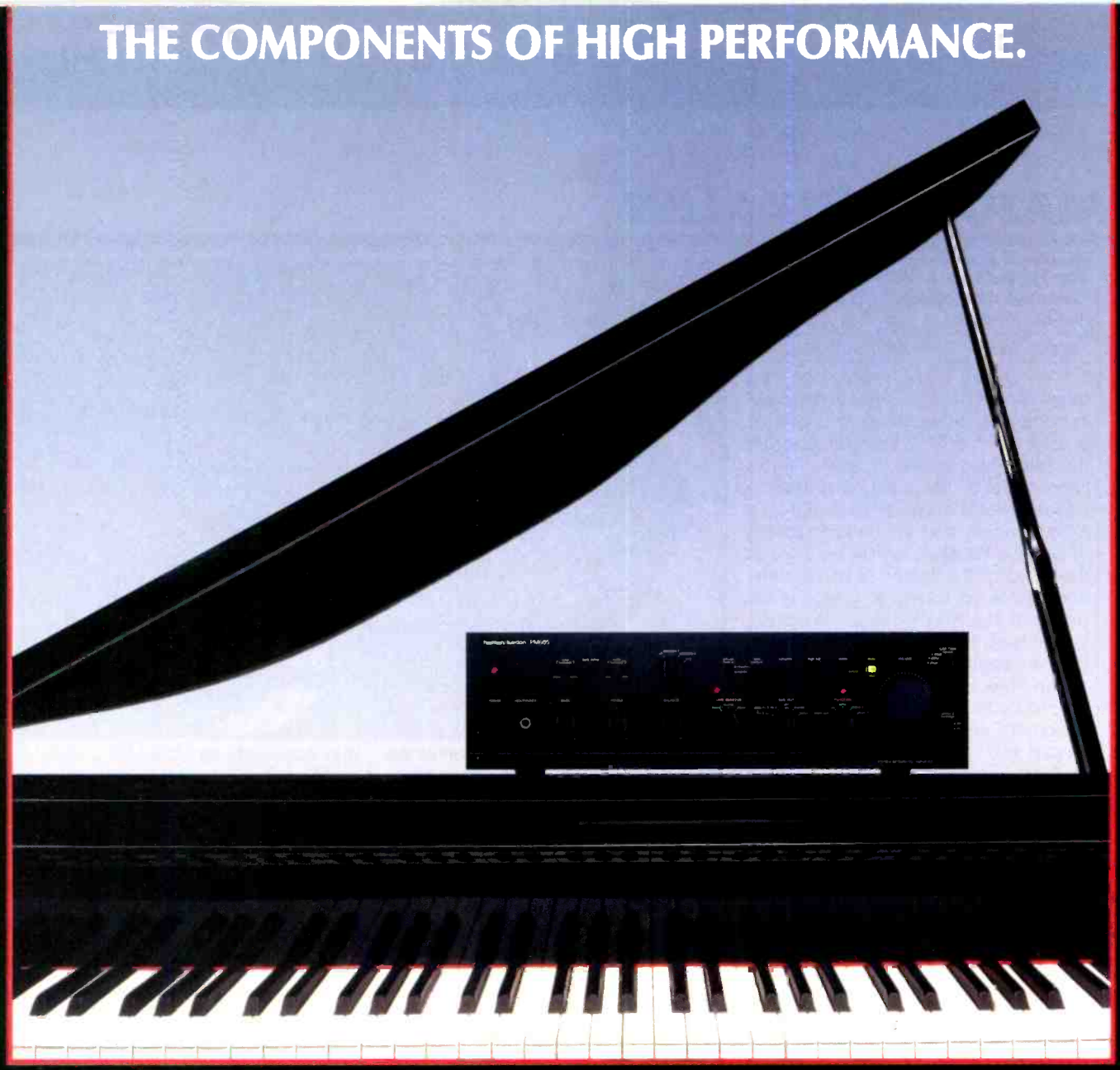

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With typical humility and little fanfare, Terry Riley has made his most important recording since *In C* was issued more than 20 years ago. Imagine the reinvented piano of John Cage's "Sonatas and Interludes," the spontaneous orchestrations of Keith Jarrett's *Köln Concert*, and the melodiousness of George Winston, all filtered through the mind of the father of minimalism, and you've got barely an inkling of the power of *The Harp of New Albion*. But you at least have a point of reference for this vanguard work.

The title is derived from a harp played by the winds on a cliff of Nova Albion 400 years ago. Riley evokes this image, and more, using a piano tuned in "just intonation," which is more mathematically precise than the "equal-tempered system" and which yields a slightly exotic sound.

Combining gifted improvisations within a structured setting, Riley conjures rich orchestral timbres with rippling spirals on "The New Albion Chorale." That's followed by the plucked Asian sonorities of "The Orchestra of Tao"; the strings are damped, and sound like an arpeggiated gamelan orchestra. Riley weaves his intricate Asian atmospheres without resorting to clichéd Asian scales and melodies, plunging beyond surface artifice into the spirit of Asian music. "Riding the Westerleys" moves from delicate gamelan-like purrs to thundering orchestral chords in a vast dynamic landscape.

To hear *The Harp of New Albion* is to experience a superimposed time compression of Riley's own music history. The rollicking overhand figures of "Premonition Rag," the rapture of "Return of the Ancestors," the Gershwinesque romanticism of "Cadence on the Wind," and the minimalist subtext of "The Magic Knot Waltz" are all culled from Riley's ongoing music pilgrimage. One can hear the sensuous ornamental curves of Indian phrasing that Riley has learned from his Indian vocal teacher, Pandit Pranath. Playing a Bösendorfer Imperial grand, Riley conjures up rich overtones and shadings, fully captured on this CD recording.

Riley altered the shape of contemporary music with his minimalist manifesto, *In C*. That epochal recording rejected the excesses and drift of 20th-century music and stripped it to an essential core. That core has exploded into the *The Harp of New Albion*, an exhaustive and refined statement from one of the most exploring minds in music. *John Diliberto*

So: Peter Gabriel
Geffen 24088-2.

Sound: A Performance: A

Like Picasso, Peter Gabriel mastered a traditional form of his art before unburdening himself of many of its restrictions. Shaking off the ornate filigree of Genesis in the late '70s, Gabriel locked himself up with a drum machine to reinvent his sound and modestly shake up rock's notion of rhythm.

The clear, clean lines of *So* spring into even sharper relief in the CD format. The music is not just a clever background for Gabriel's insightful lyrics about the joys and ironies of self-realization; it has a life of its own and a personality that is, as we might expect, dominated by rhythm.

So important is percussion to Gabriel that he recorded his drummers in Brazil with a team of specialists who make it sparkle. The four drummers on *So*, often playing in tandem on the nine tracks, were each put to their best use: Stewart Copeland for punchy bounce and especially for scintillating high-hat on "Red Rain," long-time sidekick Jerry Marotta for solid supportive grooves, Manu Katché for his African sensibility, and Djalma Correa for mesmerizing hand percussion on "Mercy Street." Additionally, Linn drum, programmed by Gabriel and others, is integrated with the live drums on four of the cuts.

The CD also spotlights the vocals. Puckish Laurie Anderson recites on "This Is the Picture" (a bonus cut on CD and cassette), and Kate Bush shows off her angelic soprano as a compassionate pioneer woman to Gabriel's disheartened settler on "Don't

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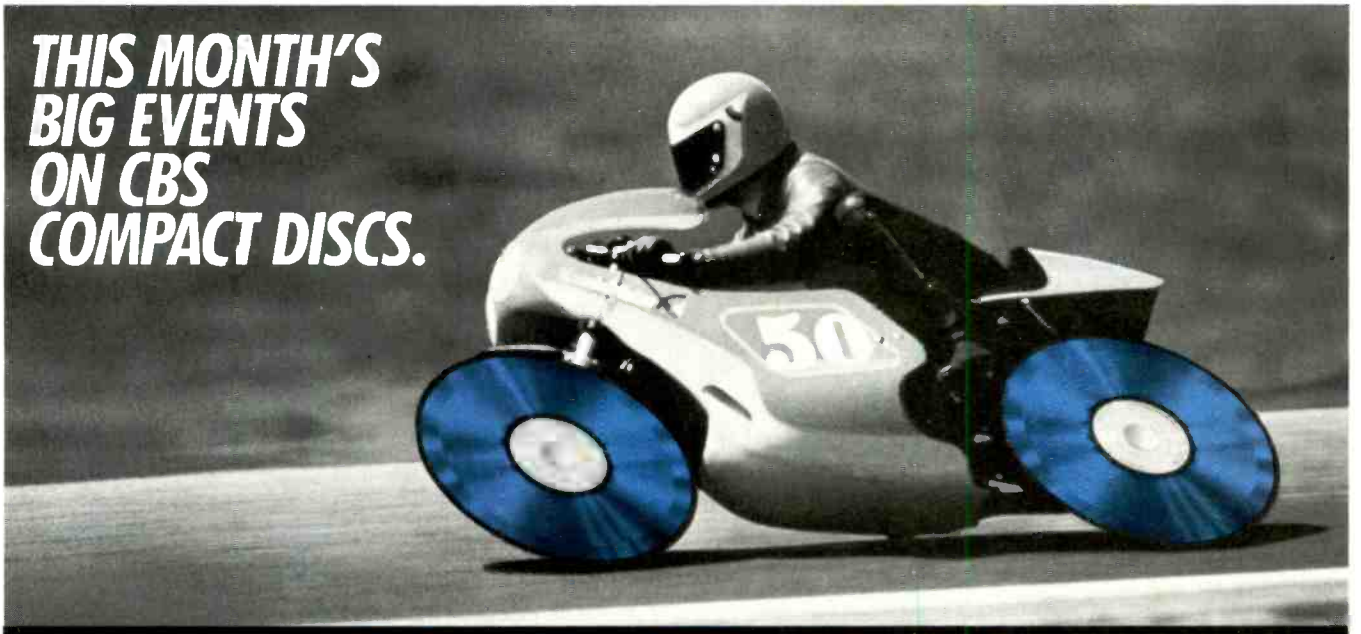

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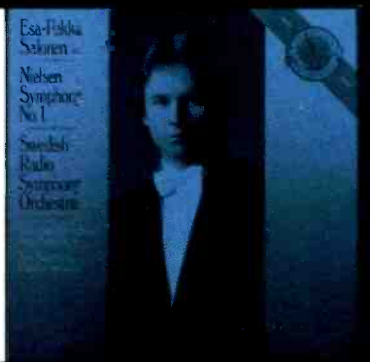

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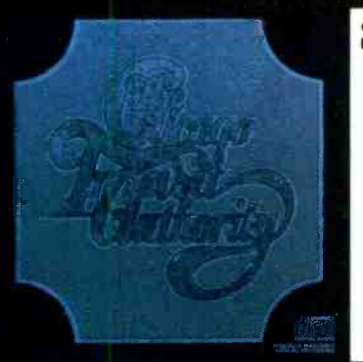

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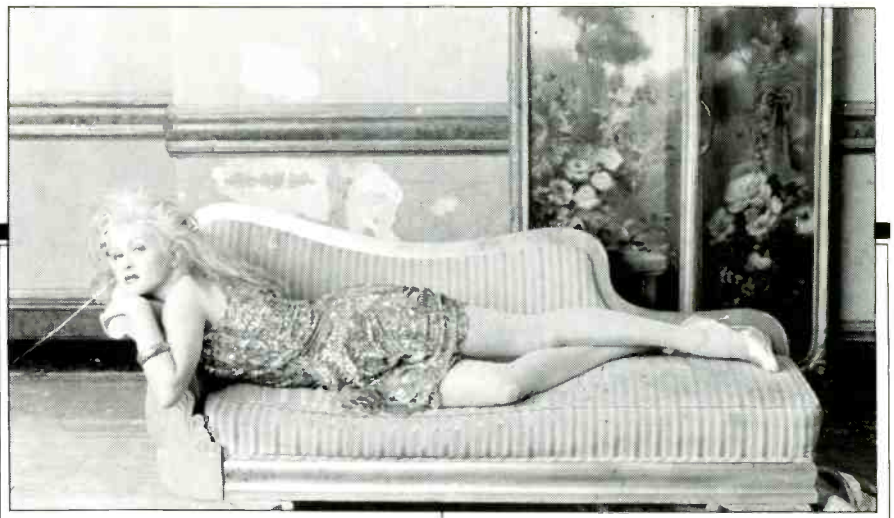

Give Up." Gabriel's voice, although more understated in the mix than ever before, is still strong and uniquely resonant. The restrained strength, and what it conveys on many levels, is what keeps this voice the most reassuring in rock music. *Susan Borey*

True Colors: Cyndi Lauper
Portrait RK 40313.

Don't let the blue lipstick, orange hair, and great gams distract you. Underneath all of Cyndi Lauper's attention-grabbing glitz is a serious artist. Her latest album, *True Colors*, will simultaneously slam the most somnambulant listener to instant attention and touch him on a visceral emotional level few rock albums ever achieve—or even aspire to, for that matter. This admirable musician has created a demanding, entertaining, and sonically athletic album that is utterly worthy of the Compact Disc medium.

Lauper chose to release the gentle, tender title track as the first single, perhaps in an attempt to ease her audience into the heavier listening to come. This cut is a gem; every nuance of Lauper's hugely expressive whisper-soft vocal is captured alive. The arrangement is splendid and deceptively simple. The rich, tubby drum, the uncluttered guitar, the delicate vocal overdub on her lead lines, the muted percussive explosions like mortar fire hitting a distant hill—all are faithfully captured in this digitally reprocessed analog recording.

When Lauper rocks out and applies her four-octave range to "Maybe He'll Know" with its '50s girl-group leanings, or slips into the big, fat sounds of "Change of Heart," she proves she can belt like a Marine yet still express the vulnerability that lies under the tough façade. Lauper takes enormous chances, pushing her voice to the limit of its ability and into the cracks between notes, going for the vocally quirky effect as well as the beautiful. She's always pushing, always stretching, never playing it safe even when the effect doesn't quite come off.

Lauper and coproducer Lennie Petze are largely responsible for the terrific arrangements and production throughout this 10-cut CD. The sinister angularity of "911," the floating, shifting vocals on "One Track Mind," and the extraordinary pockets of silence in "The Faraway Nearby" all speak of overtime in the studio on this one, and the results are impressive. Digital reproduction perfectly clarifies and underscores the enormous amount of effort that went into making this album. Cyndi Lauper deserves to be at the top of the chart and on your CD shelf forever. *Paulette Weiss*

Chris Swansen and Phil Woods

Piper at the Gates of Dawn: Phil Woods, Chris Swansen
Rykodisc RCD 10007.

On first impression, this album sounds like a big-band recording. With just a handful of players, Phil Woods and Chris Swansen have created the effect of a much larger ensemble, thanks to a sensitive blend of acoustic instruments and synthesizers, and tasteful use of multi-tracking. For their efforts, they earned a Grammy nomination for best jazz performance by a group. The album is a tribute to the late Charlie Parker, and it includes some of his compositions along with pieces written by Woods and Swansen in his honor. Parker's daughter Kim sings on two of the tracks.

Woods and Swansen have a keen ear for big-band-style colors. Often, it sounds as if a muted brass section is mixed with the woodwinds, but unmuted brass almost never is heard. Listen, for example, to " 'Round Midnight," where a synthetic muted trumpet line enters, providing a nice foil for the sax and Kim Parker's voice. When the full ensemble takes over, the pseudo-trumpet section wails away, with the lead trumpet at the top of its range. Woods and Swansen, as producers, add to the illusion by placing the trumpets in the expected position at the back of the stage, while Woods' sax comes through in similar style but in the foreground. During the sax solo, cool woodwind chords accompany Woods. This is a wonderfully subtle mix in which real sax tracks have been blended with the synthesizer. Then everything pauses—even the artificial woodwinds. By this time you're a believer, until they pull the rug out from under you as all the woodwinds slide upward with an electronic pitch bend, merging with a sustained note in the brass.

In Woods' composition "Goodbye Mr. Evans," Swansen concentrates on quiet, cool woodwind colorations to accompany Woods' sax solo. And what a beautiful solo it becomes, as he wanders casually through all the registers of his instrument. Steve Gilmore's imaginative bass line provides a solid foundation filled with interesting melodic twists and turns. Suddenly, a min-

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vol. 8, no. 4

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The clarity of *Born Tuff* spotlights the careful attention Eddy Grant has paid to the placement and tone of his synthesizers.

ute into the song, the electric brass enter with screaming trumpets that sear right through your head. Quickly things settle down, leaving only the memory of that fiery peak amid the quietly glowing embers of its sound in the background. Woods' cadenza during the final 20 seconds is magical in its effect. In less than 2½ minutes, an immense amount of emotion is packed into this epitaph for Bill Evans.

Swansen's title track captures the spirit of Charlie Parker in a fast-moving rouser full of references to his music. Parker's own composition, "Once You Know She's Gone," shows the mellow, lyrical side of his musical personality.

Some will object to the use of synthesizers and studio techniques to fill out the arrangements. But the proof of their validity lies in the beauty of the musical results. Woods and Swansen haven't attempted to synthesize a big band from scratch. Rather, they have extended the sound of their group, adding color and effect to enhance their musical intentions. Moreover, they have done it with knowledge of what the instruments should sound like, and with consummate good taste. Rykodisc's transfer to CD is crystal clear.

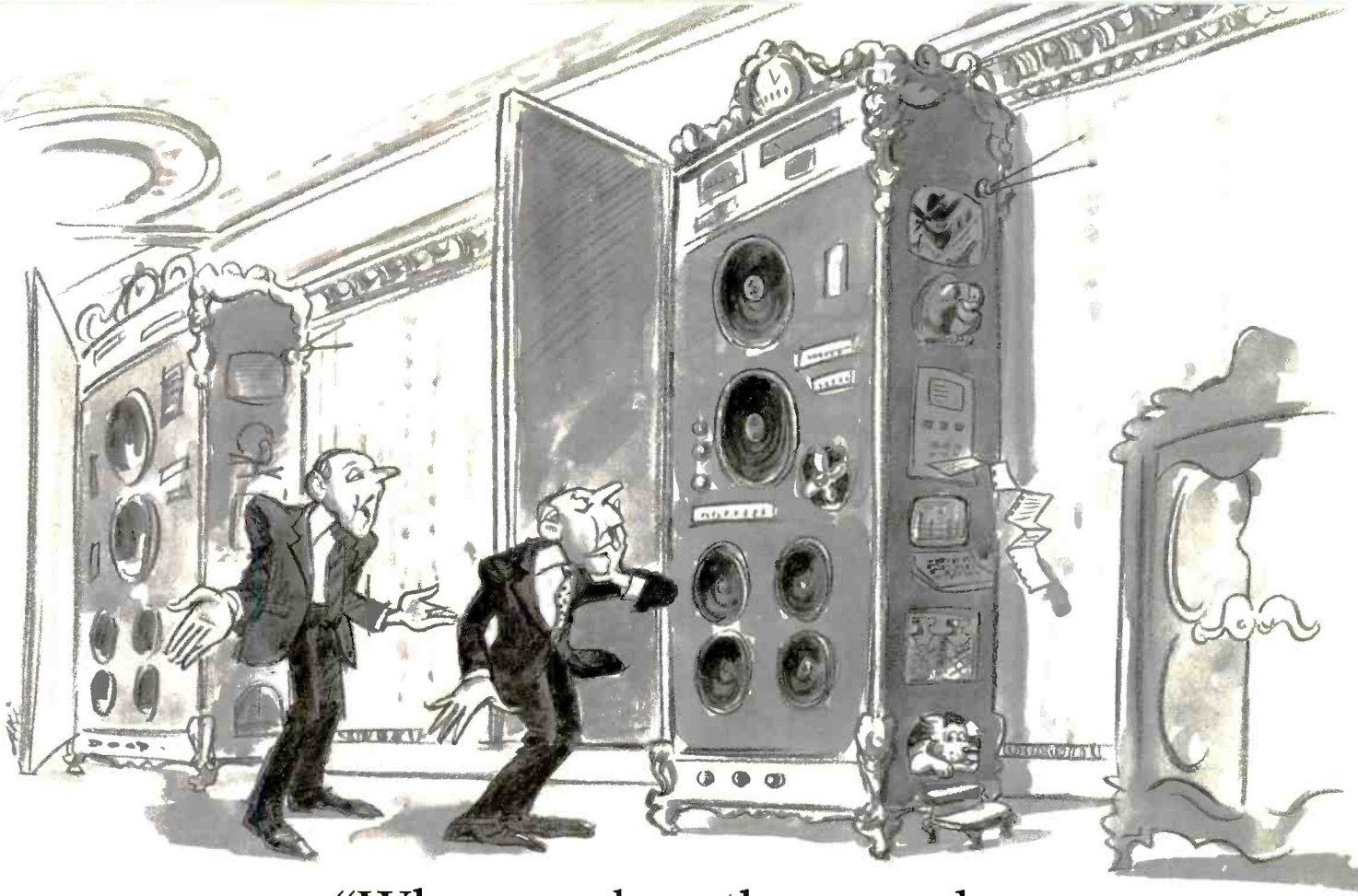
Steve Birchall

Born Tuff: Eddy Grant
Portrait RK 40284.

Sound: B Performance: C

Rock and pop have helped themselves to Caribbean music's trademark traits for a long time now. It's been a smooth incorporation, easy on the ears; indeed, using reggae rhythms has become *the* stock way to lighten up any rock song's guitar part. Caribbean artists have certainly borrowed from rock and pop as well, at their best using howling guitars to pump up a passage, and at their worst cluttering up an arrangement with competitive rhythms or distracting instrumentation. Eddy Grant, London-raised but Caribbean-rooted, sidesteps both the pitfalls and peaks of attainment on *Born Tuff* by abandoning any attempt at cross-pollinization.

Grant's rock tunes reflect a number of mainstream styles, from The Kinks to Pat Benatar to perky synth-pop. His fascination with synthesizers is spotlit by the CD format; its clarity shows his careful attention to tone and placement in the mix. "Melody of the Night," a standout cut, is positively Springsteen-



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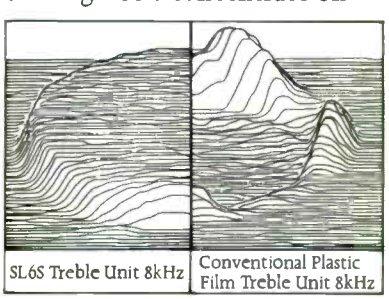

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Robert Fripp has used live, amplified acoustic guitarists to build layers of repetitive textures over which he solos.

ish and as jubilant as any of the buoyant Caribbean songs on the album.

Grant's survey of styles, perhaps intended to grab a wider audience, gives *Born Tuff* an uneven tone, but in this case a bouquet of subspecies is better than a garden of weak hybrids.

Susan Borey

Live!: Robert Fripp and The League of Crafty Guitarists
Editions EG EEGCD 43.

Sound: A Performance: B

In your mind's ear, imagine post-Eno Frippertronics synthesizing Philip Glass serialism with gamelan's communal meditation and West German guitar-choir precision, and you have a pretty good idea of what Robert Fripp and The League of Crafty Guitarists' latest avant-garde CD project is all about.

Tossing out tape loops in favor of 17 (count 'em!) live, amplified, acoustic guitarists (students from his West Virginia Guitar Craft camp), Fripp creates layers of repetitive textures over which he more or less solos. These cleanly recorded melodic meanderings range from gentle, spiralling oriental scales ("Circulation") to modern dissonant blips ("A Fearful Symmetry") and near-neurotic frenzy ("All or Nothing !"). The only electric guitar and electronic effects appear on the mesmerizing tone poem, "The New World."

Combining exotic expressionism with controlled enthusiasm, Robert Fripp's *Live!* achieves a cathartic New Age ambience with enough variety and interest to elevate it above the monotony frequently found in much of that genre.

Michael Wright

Tartini: Concerti per Violino. I Solisti Veneti, Claudio Scimone; Uto Ughi, violin.
Erato ECD 88096.

Here are three Baroque violin concerti from Tartini, a slightly later, more fruity Baroque than that of Vivaldi and the founder of it all, Corelli. If you are a "Four Seasons" man or woman, you might find this set of movements an interesting comparison. Oddly, there were poetic accompaniments here too, in words, but they were published in some sort of code so as to be unreadable in case officials of the Church disapproved! Like the other Italians of the time, and plenty more, Tartini was a pioneer in fancy new fiddle techniques. He's not so far from his later successor, the devilish Paganini, who could probably play a concerto with his teeth if he really had to.

Unfortunately, there are a few debits. The recorded balance is oddly old-fashioned—maybe they still do it this way in Italy. The main group of strings is only around 15 players, but they sound like 1,001 strings—okay, if exaggerated. But the soloist, Uto Ughi, is blown up so much that in the main you hear him as loudly as all the other in-

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John Adams' big piece is a new synthesis, still clearly minimalist but much fuller and rounder.

struments put together. We haven't done that with solos since the 1930s. (Well, not often.) It makes for monotony, and it is distracting. Yet you may like it that way, even so. And you can always turn the whole thing down to polite background music.

Edward Tatnall Canby

John Adams: Grand Pianola Music; Steve Reich: Eight Lines, Vermont Counterpoint. The Solisti New York; Ransom Wilson, flute.
Angel/EMI CDC-7 47331 2.

No, this is not the early President of the U.S. Nor, for that matter, is there any very audible pianola here. Just a CD full of quite fascinating minimalist music. Wonderful disc.

Minimalist music is easy enough to recognize, whether in some exalted symphonic format or in the most mundane of commercials. It repeats, in hypnotic patterns, always the same but always changing, by degrees. You have heard it a million times. It started with electronics. But the big news, of course, is that it has been transferred to live performance, where the job is extremely demanding.

The two shortish pieces by Steve Reich are of the classic sort, spare and disciplined but arresting to hear. Reich makes no compromises towards slick popularity in the Philip Glass manner. The big piece, by John Adams, is a new synthesis, still clearly minimalist but much fuller, rounder, less rigid, with an easy variety that does not detract from its overall shape. I loved it.

Edward Tatnall Canby

Red Hot and Blue!: George Wright **Banda DIDX 438.** (Available from Banda Records, Box 392, Oxnard, Cal. 93032.)

Back in the '50s, some of the best demo records you could buy were the George Wright theater organ recordings on the Hi-Fi label. In the early days of the stereo disc, these records truly stretched the limits of what the medium could do. More often than not, you were impressed (or appalled) at what the medium could *not* do, in terms of bandwidth and distortion at the inner grooves.

Over the years, the theater organ has waned in popularity, and for some time it looked as though there never would be a CD of the instrument! Banda Records has corrected the situation with this release, and a real stunner it is, too. Wright plays on a large instrument in his home; it is in superb shape and regulation, and has been beautifully recorded. One can hear rich textures with massive bass and nary a hint of IM distortion.

Wright's program consists of a variety of pop tunes, and the playing shows the same flair and wit that were his hallmarks in the '50s. If you're a theater organ buff, I heartily recommend this CD. *John M. Eargle*

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MICHAEL TEARSON
JON & SALLY TIVEN

STERLING STONES

Photograph: Michael Portland

The London Albums, Remastered: The Rolling Stones
Hot Rocks 1964-1971, London 66671; Aftermath, 74761; Between the Buttons, 74991; Their Satanic Majesties Request, 80021; Beggars Banquet, 75391; Through the Past, Darkly, 80031; Let It Bleed, 80041; Get Yer Ya-Ya's Out, 80051.

Why, you might ask, is *Audio* addressing all these old Rolling Stones albums? Well, friend, the whole London Records catalog of The Stones has been digitally remastered from the original master tapes. The producer of most of these records, Andrew Loog Oldham, who was also the band's manager for years, has participated in the remastering. And all the new pressings are on 100% virgin vinyl.

It thus is hardly surprising that these records sound better than ever—clearer, crisper, and more accessible. The digital remastering has eliminated or at least minimized the wash of noise that almost invariably went with rock 'n' roll records in the '60s, particularly the early '60s. And, of course, the new pressings are free of the clicks and pops the years have worn into my old and battered copies.

Generally, the older the original, the more improvement in the new edition. Early hits like "Time Is on My Side," "Play with Fire," "Satisfaction," and "As Tears Go By" (all on *Hot Rocks*) are the most surprising: Words become clearer (especially in "Satisfaction"), instruments are rendered with more authority, and the very scope of the mix is widened.

The albums that benefit the most, of those I auditioned, are *Between the Buttons* and *Their Satanic Majesties Request*. *Buttons* was a transitional work, largely an uneasy interweaving of acoustic textures and fuzz tones, with songs that wore on their sleeves the influence of Bob Dylan's then-revolutionary songwriting. *Satanic*, then and now perceived as The Stones' answer to the challenge of psychedelia laid down by The Beatles' *Sgt. Pepper* earlier that year (1967), remains one of the densest Stones projects ever, with a host of exotic and weird sounds and textures. In each of these cases, the added clarity brought by digital remastering is a real boon.

Beggars Banquet and *Let It Bleed*, the most recent studio albums here, don't gain as much, but they do sound finer than before. *Get Yer Ya-Ya's Out* remains the best live Stones album, as it catches them at their crowd-baiting nastiest (I love that moment before Chuck Berry's "Carol" when Mick says to the crowd, "You don't want my trousers to fall down, do you?"). Here, remastering adds more presence and oomph to the sound.

The packaging of the albums remains the same, with some notable exceptions. The biggest is that after all these years, *Beggars Banquet* is finally released in the urinal-graffiti cover the label censored the first time. *Satanic* does not have a hologram on the cover—but then again, it hasn't for many years. *Through the Past, Darkly* no longer has an octagonal cover, and the florid pink inner sleeve of *Let It Bleed* containing the credits is now printed on mundane white paper. All cosmetic matters, but noteworthy.

For me, renewing a close acquaintance with all these great records has been a task of special pleasure. I still regard this period as The Stones' best, as it is full of performances that have aged extremely well. Heck, most of these old records sound as fresh as ever.

And you know what? On the material I've compared to the CD versions (*Hot Rocks*, *Banquet*, *Bleed*, and *Satanic*), I find that I actually prefer the LPs. The LP sound generally has a warmth that in the less forgiving CD format becomes hardened. Hey, these were made as LPs with the limitations of that format in mind, and were intended at the time to sound "dirty." The new digital remastering enhances the LPs substantially while keeping them close to The Stones' original intentions.

Michael Tearson

London 0 Hull 4: The Housemartins
Elektra 60501-1.

Sound: C Performance: B

The Housemartins are a musical mystery. They're not very pretty, they don't wear the latest fashions, and they don't play high-tech synth rock. Yet here they are with an album and a major record label behind them. What is going on?

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The Housemartins' U.S. debut album lacks a sharp, clean sonic quality, but there is much good music to be absorbed.

The Housemartins offer straightahead rock/pop with a conscience. The instrumentation is minimal—guitar, drums, bass, and an occasional harmonica, plus piano on three tracks. The vocals, favoring basic three-part harmony, generally get a no-nonsense delivery from lead vocalist P.d. Heaton.

Nearly all the songs on *London 0 Hull 4* comment on the social situation: Hunger, unemployment, social and political apathy. While often the lyrics and music don't seem to match neatly to form a seamless presentation, *what* is being said and the appealing minimal arrangements combine to provide very good music.

If there is any drawback to this album, it is the production. Although the band is certainly a throwback in terms of looks and music, and the label is obviously playing that up in its publicity, there is no need to avoid the latest in recording technology. The album does not have a sharp, clean sonic quality. The drums could have been recorded and mixed tighter (less ambient) and with more presence. The songs could use a stronger drive to propel them, and a more solid drum mix would have done the job. Generally, though, the final pressing is fairly quiet and of good quality.

It remains to be seen how American audiences—who usually like their rock and pop to be much less thought-provoking—will take to The Housemartins. Nonetheless, there is much good music to be listened to and absorbed on their American debut album.

Hector G. La Torre

Shelter: Lone Justice
Geffen GHS 24122

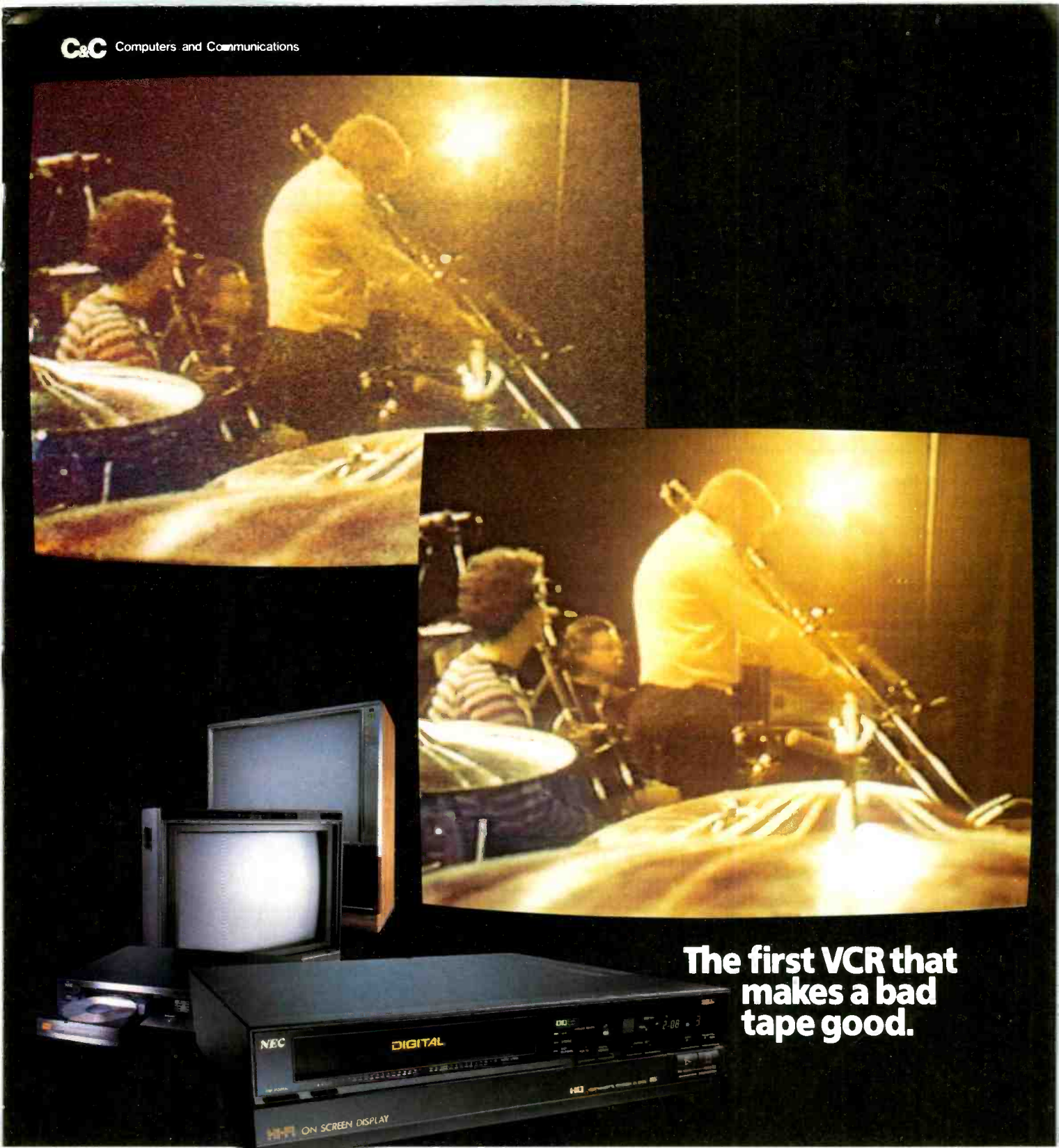
Sound: B– Performance: B–

What a difference a year makes! On the second Lone Justice album, singer Maria McKee and guitarist Ryan Hedgecock are the only holdovers from the first (and Hedgecock too has since left). The balance of the country-and-rock fusion of the debut has been tilted firmly to the rock side as the calico trimmings have been pared away. Buttressing the rock edge are the strong sensibilities of producer Jimmy Iovine and new coproducer Little Steven Van Zandt.

The shining beacon of Lone Justice remains the nervy singing of Maria McKee, who also cowrites all the music and writes nearly all the lyrics herself. Some of her songs are spacey ramblings reminiscent of a younger, less worldly Stevie Nicks (the sermonesque "The Gift" most notably). "Shelter" and "Wheels" are outstanding songs, each a churning plea for connection. The opening song, "I Found Love," sounding like a deliberate shot at a hit single, is a strong rocker in a classic mold, cowritten with Little Steven. Maria's lyrics often seem conversational. This is alternately a plus and a minus; the naturalism she is reaching for occasionally becomes awkward as she struggles to make her words fit the music. Even so, she's a whale of a singer, and someday she will definitely be a star.

Shelter's sound is straightforward rock, much like that of Tom Petty—not surprising with Iovine at the helm, since he has done a lot of Petty too. There are enough little touches both in production and songwriting to keep things somewhat varied. The deployment of multi-tracked McKee voices and judicious use of guest backing singers are prime ingredients in this.

Lone Justice isn't all the way there yet; still, their evolution is an interesting one. *Shelter* is a better-recorded album than the debut, and that is always encouraging, but the jettisoning of the band's country side (while probably a smart commercial decision) costs them some charm. *Michael Tearson*



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With its tight little band, Eric Clapton's *August* is good-natured and spirited enough to make for some very pleasant listening.

August: Eric Clapton
Warner Bros. 25476-1.

Sound: B– Performance: B–

August is another comfortable Eric Clapton album. Even though nothing really startling is going on, it's all good-natured and spirited enough to make for some very pleasant listening.

Phil Collins, who produced most of 1985's *Behind the Sun*, returns for all but one track of *August*, working "in association with" Tom Dowd. The exception is "It's in the Way That You Use It," produced by Clapton and Dowd from the soundtrack of the movie *The Color of Money*. (By the way, the soundtrack LP, on MCA, is an uncommonly good one, featuring Clapton, Don Henley, B. B. King and others.) Throughout *August*, Dowd's stamp is evident. He has worked with Clapton for most of Eric's solo recording career, and his reputation is well-earned for not allowing subpar work under his name to surface.

Most of *August* is up-tempo. Except for "It's in the Way," there is a tight little band with Greg Phillinganes on keys, Nathan East on bass, Collins on drums, and, of course, Clapton on guitar. Five songs feature Leon Pendarvis horn charts that are much in the style of Collins' solo albums. Tina Turner adds vocals to two tracks, and Procol Harum's Gary Brooker contributes piano and vocals to "It's in the Way." Throughout, the band's playing is very fine. I must note that Collins the producer gives Collins the drummer an uncommonly generous and juicy place in the final mix.

Clapton sounds more interested here than he did on *Behind the Sun*. There, I found his performance mechanical; he sounds more emotional here. All in all, *August* is another fine Clapton album. Not extraordinary, but quite consistent and solid.

Michael Tearson

Flaunt It: Sigue Sigue Sputnik
Manhattan 53033.

Sound: B Performance: C+

Ever since The Sex Pistols, the British music industry (and public) has seemed fascinated with rock swindles. Now here's Sigue Sigue Sputnik, the latest in a long line of Frankie Goes to Hollywood-ish contrivances. What SSS is, is Tony James (formerly of Generation X) coming up with a Billy Idol sound-alike and a wholly ridiculous-looking band. They can't sing or play, and they can barely write.

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Elton John's pointlessly busy arrangements are meant to hide the empty clichés at the heart of some of his songs.

The album is a collage of James' ideas executed primarily by Giorgio Moroder's digital arsenal of drum machines, synths, and outboard gear. Only on "Love Missile" does any excitement result, although there are a couple of amusing flops. The Sex Pistols were successful only because they had an unusually gifted songwriter in Glen Matlock. SSS's progenitor isn't exactly an original talent. Nice logo, though. *Jon & Sally Tiven*

Leather Jackets: Elton John
Geffen GHS 24114.

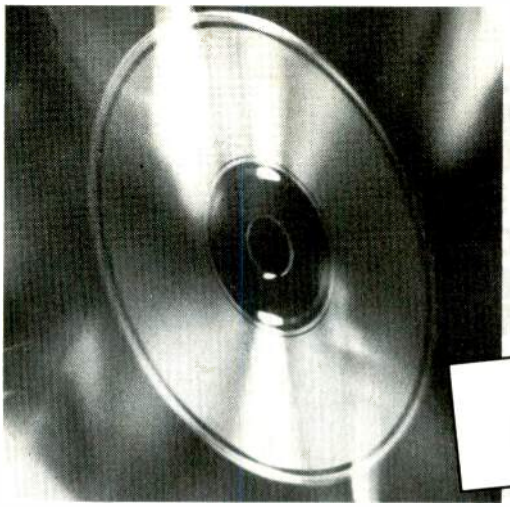
Sound: C Performance: C+

In the beginning of their careers, Elton John and Bernie Taupin seemed to know both the question and the answer. The question was, "Where to now?" and the answer was a string of pop albums that, for richness of harmony, melody, imagery, and language, rivalled those of Stevie Wonder and The Beatles at their most inventive.

But then a sort of artistic Alzheimer's descended, erasing first the memory of the answer, and then the memory of the question, so that for a long time now John and Taupin have wandered aimlessly. John has been turning out albums virtually without content, exercising considerable proficiency in the service of next to nothing.

The title, the cover, and the first cut of John's latest album are particularly bankrupt. If there *is* something worth saying about the studded-leather-jacket-and-chains crowd, John and Taupin studiously avoid it and present an empty fashion statement instead. Sometimes a song is so bad that John and producer Gus Dudgeon resort to a pointlessly busy arrangement and a mix filled with synthetic chatter and hiss to disguise the empty cliché at its heart. John's tendency to use synthesizers where formerly he would have used a piano is a sad attempt to make up for the lack of real musical content.

But there are some signs of remission among all these tokens of disease. The clutter and congestion of side one give way on side two to more focused arrangements and warmer, more spacious mixes. Elton's harmonic content sometimes shows some genuine progress, in terms of sophistication and heartfulness, even occasionally begging comparison to recent Joni Mitchell. In fact, some of the songs are so tantalizingly reminiscent of John and Taupin at their soul-searching best, one suspects the answer would soon come to them, if only they'd remember the question. *Susan Borey*



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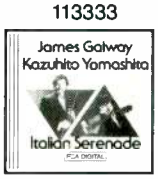

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Living in the 20th Century has the same bouncy and spacey-sounding high-tech pop that Steve Miller has been doing for years.

Living in the 20th Century: Steve Miller Band
Capitol PJ12445.

Sound: B Performance: C–

Even a quick listen to *Living in the 20th Century* gives the impression that Steve Miller didn't have a whole lot to say this time. Side one contains the brand of bouncy yet spacey-sounding high-tech pop that Miller's been doing for years, including a couple of instrumental tracks. One cut, "Nobody But You Baby," is more than a little reminiscent of Miller's hit "Jet Airliner." Side two contains rehashed R&B, with four songs originally performed by Jimmy Reed and one Miller original. There's nothing very fresh at all; it's an obvious holding action.

Technically this is quite a fine job, as Steve Miller albums generally are. The sound of the band is bright and happy, even on the moody songs of side one. The result is music so lightweight it nearly floats away. Pleasant for sure, but it's all too easy. *Michael Tearson*

Between Two Fires: Paul Young
Columbia FC 40543.

Sound: B Performance: B–

Paul Young is a first-rate singer, perhaps the brightest hope England has produced since The Pretenders. His band, featuring superior bassist Pino Palladino and the newly returned-to-fold guitarist Steve Boltz (nee Bolton), is composed of great players who have forged a unique sound. His latest album is produced by Hugh Padgham, who has gotten some amazing sounds from the fretless bass and Ian Kewley's digital keyboards.

So what is Young doing singing a bunch of second-class songs?

Don't ask us. His first album had a bunch of tastefully chosen songs initially rendered by Marvin Gaye and Don Covay, as well as a few originals which were—er—dispensable. Nobody said Elvis Presley was a writer, either, but he managed to sustain a career by selecting A+ songs and cowriting with A+ writers. With two exceptions, all of the songs on this album were written by Young with Kewley and Palladino, and this combination has only come up with one decent song ("Between Two Fires"). The first U.K. single, "Wonderland," written by Betsy Cook, stands miles above the rest of the album, but doesn't even come close to "Everything Must Change" or "Tomb of Memories" from the last album (both of which were written by Young and Kewley).

The record sounds are wondrous—Padgham is a fine recordist and knows how to hit the G-spot in your stereo every time—but as a producer, Hugh P. lets a lot go by him that, musically speaking, really shouldn't get recorded. Steve Boltz is a welcome re-addition to the band, but he barely gets a note in.

Even though Paul Young's first record is his least polished, it still stands as his best. You need not ask where this one falls. Hope that Paul remembers what he's best at, and in the meantime, go out and buy the British 12-inch disc with "Wonderland" and "Between Two Fires." You'll have the best parts of this album.

Jon & Sally Tiven

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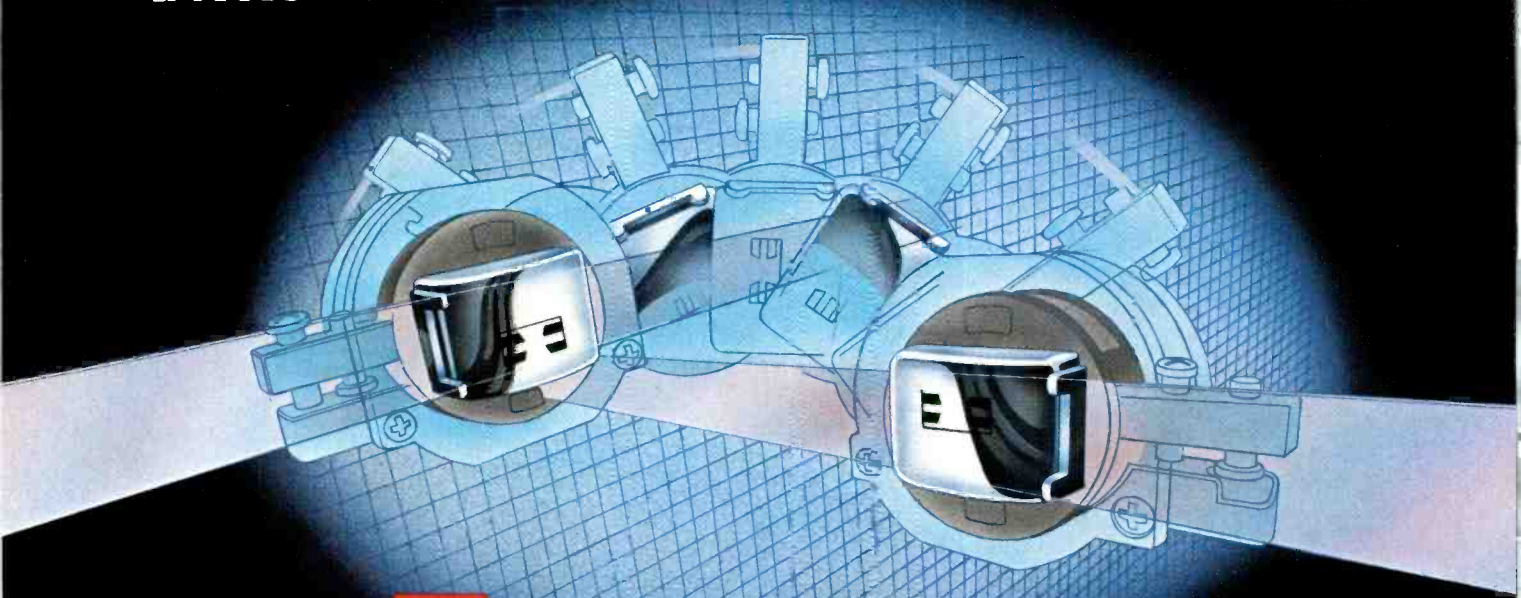

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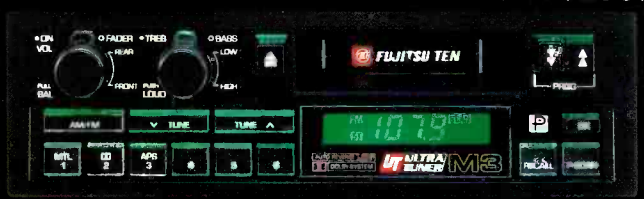

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Chrissie Hynde's familiar low purr is missing from *Get Close*, but when she hits the mark dead-on, it's worth the price.

Get Close: The Pretenders
Sire 25488.

Sound: B– Performance: A–

In evaluating any album by The Pretenders, one is forced to compare the current work with the first two albums, which is inherently unfair. Jim Scott's contribution as guitarist, arranger, and co-writer was highly underrated, and it goes without saying that he probably never will be replaced. The group sound, as a result, has changed somewhat, and it hasn't always been for the better. But despite this hardship, Chrissie Hynde-Kerr continues to come through with a couple of songs per album which are among the best-written (and sung) of any year. Here they are "Chill Factor," "Don't Get Me Wrong," and to a somewhat lesser extent, "My Baby."

One must look upon *Get Close* as yet another transitional album. Chrissie was putting together the band as the record was being made, and the personnel differs greatly from track to track. There are three cover tunes on the record, and sad to say they're all substandard. The recording was produced by Bob Clearmountain and Jimmy Iovine, who have done fine with the backing tracks but missed out completely with the trademark Hynde vocal sound. There's an uncomfortable treble edge to her voice that's unique to this recording, and the familiar low purr is lost (wrong microphone, fellas). Yet despite all this, when Chrissie hits the mark dead-on, it makes it worth the price of admission. *Jon & Sally Tiven*

Rockbird: Debbie Harry
Geffen GHS 24123.

Sound: C Performance: D+

Debbie Harry and her creative clan must have figured that the kids she titillated 10 years ago have all become junior investment bankers. *Rockbird* is mainstream flotsam, perfect music for yuppie beer commercials.

The little that this music has in common with Blondie is a liability now. As reigning Snow Queen in an era of raw, rough hyper-passion, Harry's deadpan vocal delivery and drop-dead demeanor were in brilliant contrast to her ranting contemporaries. Now, against reined-in, subdued arrangements, Harry's carefully constructed persona is barely visible, like a polar bear in a snowstorm.

The blame for this album's tepid tone doesn't lie solely with Harry. Producer/arranger Seth Justman has gambled on an "up-to-the-minute" sound, complete with machine-programmed drums and bass and the ever-hip Uptown Horns. It's just that nothing about it is really strong enough to pull the whole project up from a mediocrity that Harry should be able to transcend.

Susan Borey

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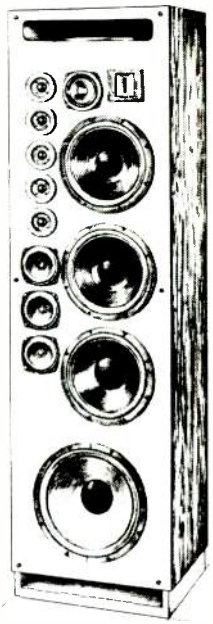

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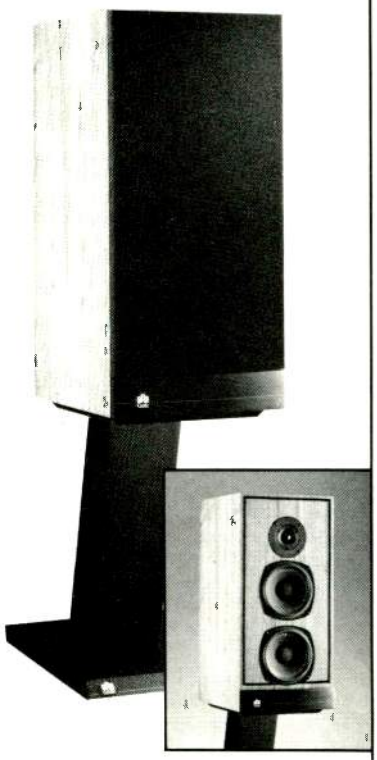

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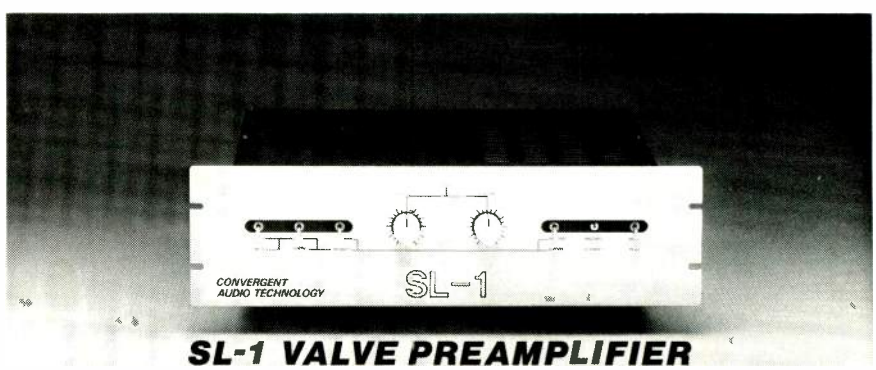

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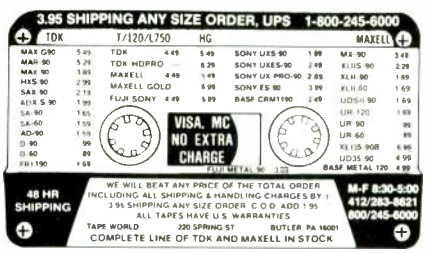

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