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The Post Group at Disney-MGM

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May/June1993 Vol. 27, No. 3

db magazine

serving: recording, broadcast and sound contracting fields

See page 6

THE RECORDING ENGINEER

See page 13

THE ELECTRONIC COTTAGE

DEPARTMENTS

About the Cover

• Rob Hill is the Senior Audio Engineer at The Post Group at Disney-MGM in Orlando, Florida. See our story on page 6.

Calendar

● **Sound in Entertainment: Scecifying and Designing Audio Systems to Create Sound Environments** is the long title of a series of seminars, sessions and exhibits that will take place November 13-15 at the **Orange Country Convention Center** in Orlando, Florida. The conference is supplemented by the **LDI93** show. Exhibits will be open 10:00 am to 6:00 pm November 13th, 14th, and 15th 1993. LDI93 is sponsored by *Lighting Dimensions* magazine. For information call **Jacqueline Tien** at 212 677-5997 or fax 212 677-3857. You can write them at 135 Fifth Avenue, New York, NY 10010

● It's not too early nor too late to start thinking about the **95th AES Convention,** which will be held this year on October 7-10th in New

db magazine

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The ELAR Audio Library

The Books You Need To Be A Better Professional

• John Eargle's *Handbook of Sound System Design* has the answers to those needs you have for accurate technical information about sound reinforcement. It contains every thing from a small church to Madison Square Garden, from live sound for 60,000 to canned sound for 600. Chapters: High-Frequency Speaker Systems, Mid-Frequency Speaker Systems, Low-Frequency Speaker Systems, Dividing Networks, Central Loudspeaker Arrays, Distributed Systems, Paging Systems, Microphones, —All this and more.

• *The New Recording Studio Handbook* by John Woram and Alan P. Kefauver is for everyone involved in recording. It is already established as the "bible" for learning all the basics of the recording studio operation. This includes the latest in the many kinds of noise reduction, analog recording, digital recording from multi-track to R-DAT, what they are and how you use SMPTE and MIDI time codes, signal-processing equipment, microphones and loudspeakers (monitors), and all about the new automated consoles.

• If you are a professional in audio and use microphones in any aspect of your work, you need John Eargle's definitive *The Microphone Handbook*. Among the topics covered are: Using pattern selectively, directional characteristics, remote powering of condenser microphones, sensitivity ratings and what they mean, proximity and distance effects, multi-microphone interference problems, stereo microphone techniques, speech and music reinforcement, studio microphone techniques, and so much more.

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York City. This time however, it will be held at the **Jacob Javits Convention Center**.

"The AES Convention Committee members agreed that the AES exhibit requirements have outgrown the **New York City Hilton Hotel** where AES Conventions have been held for several years,"according tp Convention Chairman **Leornard Feldman**.

"Our experience at the 93rd AES Convention in San Francisco confirmed the advantage of having all exhibits on a single floor—a benefit that could not be achieved at the Hilton."

The dates include a Saturday stay, offering advantages to attendees for lowest discounted air fares, while exhibitors will benefit from weekdays being used for setup and breakdown, thus avoiding overtime charges. According to Len Feldman, "the dates of October 7-10 were not available at the Hilton."

For information, contact the AES at 60 East 42 Street, New York, NY 10166, or call at 212 661-8528.

● "Big" Ed Learned is off again on an USIA tour of Africa, this time with Kenny Neal (Blues Quartet). Here's the schedule:

May 4-8 Addis Ababa, Ethiopa
May 9-11 Mombasa, Kenya
May 12-15 Nairaobi, Kenya
May 16-19 Entebbe, Uganda
May 21,24 Kigali, Rwanda
May 22-23 Butare, Rwanda
May 25-27 Bujumbura, Burundi
May 29-31 Dar Es Salaam, Tanzania
June 1-4 Lilongwi, Malawi
June 6-9 Antanandrivo, Madagascar
June 10 Return to U.S.A. via Paris, France

Now that he's back, watch these pages for the stories of his new audio adventures db

1993 Editorial Calendar

JAN/FEB *The Electronic Cottage and Project Studios.*
Winter NAMM Show issue.
• GUIDE: Speakers: Performance & Monitor.

MAR/APR Radio and TV Audio/Sound Reinforcement in Permanent Installations.
NSCA & NAB show issue.
• GUIDE: Consoles and Mixers, Work Stations.

MAY/JUNE *db Visits Houses of Worship.*
• GUIDE: Power Amplifiers.

JULY/AUG Live Sound—Intimate Clubs to Major Stadiums.
• GUIDE: Tape, Tape Recorders and Accessories, Microphones.

SEPT/OCT *State of the Recording Art.*
AES in New York Show issue.
• GUIDE: Signal Processing Equipment, Part I, (delays, reverbs, crossovers, equalizers).

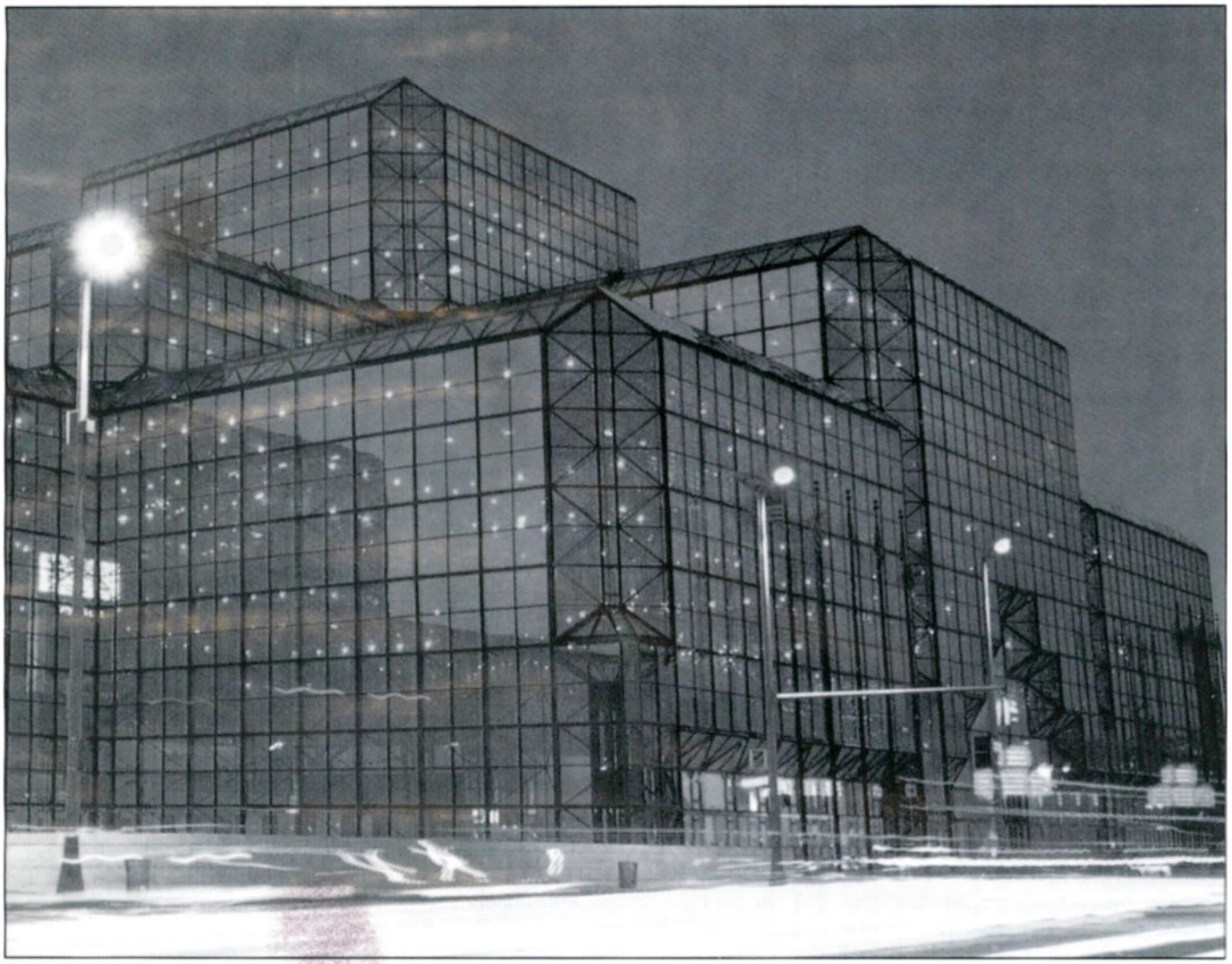
NOV/DEC *Post Production—Coast to Coast.*
SMPTE in LA Show issue.
• GUIDE: Signal Processing Equipment, Part II, (noise gates, noise reduction, limiters, compressors).

NAMM—Jan 15-18 (Anaheim)NAB—April 18-22 (Las Vegas)
NSCA—April 2-4 (Orlando)AES—October 1 2-Nov 2 (New York)
SMPTE—October 30-Nov 2 (LA)NAMM—1994 Jan 21-24 (Anaheim)

The AES 95th CONVENTION

DATES: 1993 Oct. 7 through Oct. 10
LOCATION: Javits Center, New York, NY

Audio In The Age Of Multimedia



AES Conventions have become a driving force in the delination of new audio technologies. The AES Convention is the listening and observation post on the frontier of audio. The 95th AES Convention in New York, **"Audio In The Age Of Multimedia"**, will provide the attendee a wide vista of the audio scene of the coming nineties. Prepare yourself for the radical departures and developments that will make the nineties the most exciting decade in audio.

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JOHN BARILLA

The Post Group at Disney-MGM Studios—Post Production Paradise in Orlando, Florida

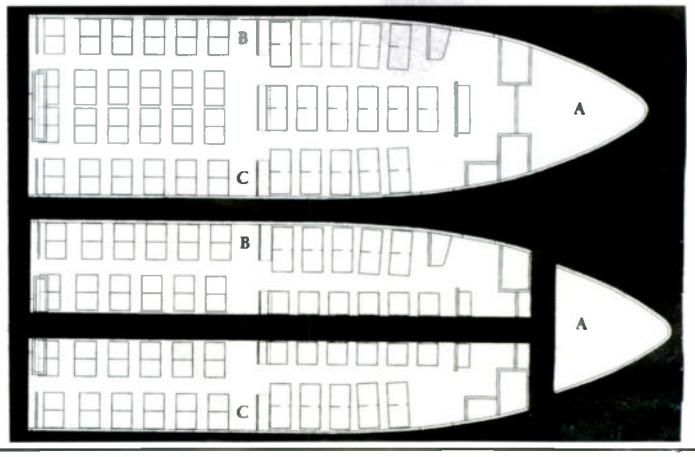
It started with a mailing from a public relations firm about the Post Group at Disney-MGM in Orlando. Coincidentally, I was heading for Orlando for the NSCA (Sound Contracting) show, so a few phone-calls later and I was set up for a tour of the facility. When I arrived, I was told where to go, and arrived at their facility with no problem. The Post Group is located well within the Disney World grounds. So while at their building, we could see the tour buses whisking by loaded with eager faces. When we returned, I asked Senior Editor John Barilla to telephone interview Jack Peter, the head of the group. This is his interview. LZ.

ORLANDO IS THE HEARTBEAT of Florida and fast becoming the heartbeat of the entire film, TV and post-production industry. While southern Florida still reels from the effects of a capricious tropical storm, central Florida has been fortuitously sheltered from all ill-fated winds and remains the entertainment and tourist-industry economic engine for much of the state. Strategically located in the middle ground between the John F. Kennedy Space center on the east coast and the healthy young city of Tampa on the west coast the Orlando area is a recreational wonderland that boasts a unique city of its own in Disney World. And while it is not at all surprising that the Disney empire (which has for several generations been the world's most prolific producer of family-oriented entertainment) should have their own studios and post-production facilities, what is surprising is that they should be servicing so many independent clients outside the Disney organization.

How can any remotely located studio complex draw clients from the major entertainment hubs like New York and Hollywood? Part of the reason must certainly be the fortuitous location with long sunny shooting days, all year long; but southern California offers a comparable climate, so why travel 3,000 miles?

A line culled from a Disney-MGM promotional brochure provides a clue: "Here's a place with the advantages of Hollywood and New York, but none of the disadvantages." What disadvantages? Things like traffic jams, air and noise pollution, special fees and

ONE OF THE UNIQUE FEATURES of the Disney sound stages in Orlando is the one that contains a full-sized L-1011 airplane! It's minus its wings and tail to be sure, and the full body is on dolly-type wheels only a few feet off the floor. But the body, which has a fully-configured and lit cockpit and passenger seats is what is truly special. The cockpit, in one piece can be rolled forward. The passenger compartment is split down its entire length for easy access for shoots, but the entire assembly including the cockpit can be seamlessly rolled together for full interior shots.



permits for shooting in public places—all of which are nonexistent on the Disney-MGM lot. One other advantage to independent producers is the liberty to work with either union or non-union technicians, crafts persons and talent—something they call "a flexible labor environment". All of this points towards cost-efficiency unheard of in New York and Hollywood.

Almost every conceivable backlot is available—even authentic urban settings from skylines to brownstones are available, not to mention the naturally occurring wetlands and forests.

But what about the post-production end of Disney-MGM; what could possibly be the advantage here when post production depends more upon equipment than environment? The success of this facility probably rests on the sheer youthfulness of the venture. They are curiously not bogged down with the resistive inertia found in older studios, such as the need to justify investments in outdated equipment.

A few years ago, under the leadership of Post Group General Manager, Jack Peter, Disney-MGM was able to rapidly upgrade and remain a state-of-the-art facility. Their elegantly simple design and cost-efficient organization allow the post facility to attract big projects from all around the world. I recently talked with Jack Peter, and the resulting conversation gives us more insight into the studio's widespread success.

My first question Jack, I've been looking at the literature on your facility, and it's quite impressive. How long has the Post Group at Disney-MGM been in operation?

Jack's reply, "Just four-and-a-half years. It's still a baby."

I then asked where did they (Disney-MGM) do their post before that?

And Jack responded, "It was at any number of places: from New York to Hollywood to Miami to a number of local places. They were kind of all over the map.

I understand that you don't do only your own work, I then asked about that?

Figure 2. The audio suite.

And Jack answered, "A good fifty percent of it is Disney or Disney driven, but part of our mandate is to increase what we call third party sales, which are true outside clients to the area."

My next question was what were you doing before you hooked up with Disney?

Jack Peter said, "Before the Post Group hired me, I was director of film post-production at Optimus in Chicago, which is a commercial film editorial house. Our paths kind of crossed at NAB one year and here I am."

I wanted to know what advantages are people finding working in central Florida now as opposed to the other centers of film and video?

Jack's reply, "Well, I think they find a certain freshness about the area and the people. By and large—at least for the Post Group operation—everyone has relocated here from somewhere else, and so there's a camaraderie, a pioneering feeling, if you will."

Sort of like California fifty or sixty years ago?

Said Jack,"Yeah, we're really trying to make this market happen, so when we get people in to do work, the attitude is generally very good. Quite frankly, equipment-wise, you can get videotape editorial anywhere in the world these days, so we really rely on the client service aspect. It's quite a nice environment to work in. And if people are working on an extended project they can take advantage of some of the Disney World features—the

Figure 1. Jack Peter.

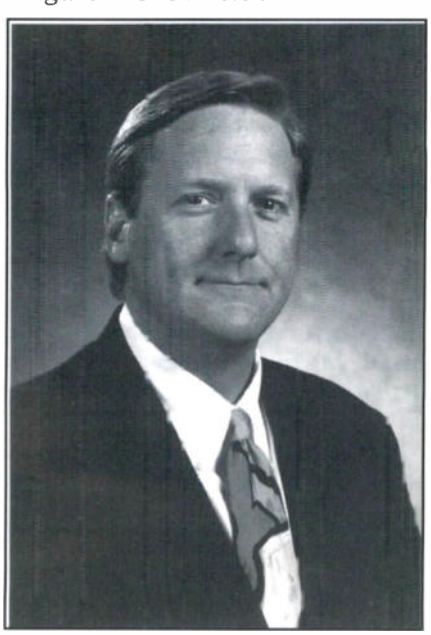


Figure 3. The Foley stage at work.

parks, the resorts, the golf courses."

I next wanted to know if there is an interesting project you've worked on recently that you'd like to tell us about?

Jack came right back with, "There's a couple of those, actually. We finished a project recently for a company in Orlando, *Renaissance Entertainment*. It was a binaural audio project that went into the space camp at the Kennedy Space Center at Cape Canaveral. It's part of the public tour out there—a big three-screen launch simulation with the audio presented on binaural headsets. It's kind of like surround sound, but it's called *binaural (Ed. Note: Binaural audio is more realistic than standard stereo imaging, having been recorded on a device that approximates the architecture of a human head).* That was a really fun project and we created most of that in the Synclavier sound design room. It took quite a bit of time, but it's gotten rave reviews out on the space coast."

I asked then, how do you lock up all the sound sources for a project like that?

Jack's answer, "The way we do it around here is we operate mostly on Sony 24-track digital recorders. We lock up to the Sonys at all points in the porches. We work off a work print in the Synclavier bay and then take it into a sweetening bay and marry the sound to the picture. I don't want to overblow it; it was a pretty straightforward process. But creatively, the fun part happened in the Synclavier room where they were essentially creating something out of nothing.

One of the other shows we just finished a run on—we've been doing ninety percent of the audio work on it anyway—is Nickelodeon's show, "Welcome Freshmen". We do all the sweetening and the mixing and that was fun. It was a nice project for this facility because it gives us some exposure to what Nickelodeon is doing. They're a local client, albeit a very big one.

"Nickelodeon is based at Universal (which also has facilities in the Orlando area). They're a Viacom company, which also owns MTV, VH1 and Nickelodeon. Right now they are occupying two sound stages at Universal, and we were able to open up a nice relationship with them. We have very extensive audio facilities here, so they try to do a lot of their audio over here."

Now, can you tell us what are the main features of your audio facility?

Jack's reply, "Our audio facility is made up of three rooms. The sweetening room is physically the largest of the three rooms, and that's where all the sweetening and final mixing happens. There's an SSL 5000 console in it, and we have the ability to loop to film or video tape. We have projectors set up above and in the back, so we're capable of mixing a feature. We're set up in Surround Sound, so we can do some pretty elaborate mixes there. Of course, it's a fully automated board. I think it's the largest board Solid State Logic makes.

"The second room is a smaller room that's capable of doing mixing, but it's tied to a Foley stage. We do an awful lot of Foley recording, ADR work, and sometimes just simple voice-over work, so the room gets used for a variety of applications. There's a Sony 3000 36 input console in the room and all the rooms are tied into a central machine room to the (5) Sony 3324 digital 24-track recorders.

"The third room is the Synclavier sound design room which also has a Sony 3000 console in it. It's a bit of overkill, I guess, but I happen to have it, so I'm using it. And that's also where we house our CD library. And we're about to purchase a hard disc editor to go along with the Synclavier, so that will round that room up pretty nicely."

I wanted to then know what sort of new audio editor might be coming?

"Actually we're leaning towards the Sonic Solutions. It's a Mac based system; it's expandable—you can start at 2-track and take it up to 24," said Jack.

My next question was; about the satellite uplink and downlink capabilities there, what is your usage of it is like?

Jack's response, "Well, primarily, the uplink and downlink gets used by a division of Disney called *Broadcast Operations* and it gets used in really a couple of different ways. One way is that the property down here is so large and so visible that there are, frankly, quite a number of celebrities that pass through. There are also a number of press conferences where some-

thing big happens with a corporation, or something happens with the Cathy and Regis show. There are points on the property that are all fiber-optically connected to our machine room—so we're linked up to them and so, for instance, if Michael Eisner (Disney president) is having a press conference out at Epcot, we can take that feed and send it up to a satellite for use by anybody in the country who can bring it down and use it for a news program.

"The other thing we're able to do is if there are celebrities that come down—like Robin Williams, because he was the voice of the genie in Aladdin, we're able to give him a national press tour without him ever leaving the complex here. We can put him on camera, send that signal to the uplink station, and all the talk shows can bring that down for their use, whenever they feel like it.

Figure 4. The Synclavier room at the Post Group.

I think we've already seen decentralization of the audio industry beginning.

"For us (the Post Group at Disney-MGM), we tend to use it when we're in a jam; when we need something looked at and reviewed quickly. We can send a signal up and bring it down in Burbank for approvals (from Disney's headquarters). And we've also used it for ad agencies in New York when they've got to review and approve a spot. It's certainly more expensive than Federal Express, but it's very immediate. It depends on what the scope of the project is and how critical the time factor is. Sometimes it might be worth a thousand bucks to get the approval instantaneously."

I asked then if Jack had any closing thoughts on where the Post Group at Disney-MGM might be headed in the future?

"I think in a real broad sense, that the industry is changing fundamentally, and the computer industry is driving a lot of that change. And we're really positioning ourselves to take advantage of that new generation of computer technology. We're seeing that certainly with the Sonic Solutions device—which is basically a computer that you can edit audio on; and we're seeing it in video with devices like Avids (a Mac-based video workstation) which are random-access non-linear systems. I think we're in a position where we're going to be able to capitalize on that and stay at the forefront of it. Certainly video tape is not going away, and audio tape is not going away, but how you get your product produced is changing fundamentally; it's being done more and more on computers. It's a history thing: we're in the right place at the right time to take advantage of that.

"We're not a twenty-year old facility, so we can still react to these changes. Some of the older facilities in Hollywood have a lot of tape machines—hundreds of them, and they know the computer future is right here at their doorstep and they want to take advantage of it, but the trick is, what do they do with all of the stuff in the machine room? We still have a fair amount of that, but I think we're small enough and still new enough to move with these changes.

"I think we've already seen decentralization of the audio industry beginning. If you've got a little bit of money you can buy a couple of these devices, put a shingle out and you're in business. But this is where the client services and the talent issues come into play. We're able to attract some really top talent; and producers and directors will always be attracted to that.

"The assumption is that you've got the equipment and you've got the technology, but facilities like ours are really full service. You don't have to run around town to get a project completed, and depending on the scope of your project, that can be a real benefit. We deal with a lot of half-hour shows and regardless of what they're about, there's a lot that goes into them. It's always easier to stay in the same facility when you're doing a complex project." db

NEW PRODUCTS

AMP COMPUTER CONTROL

• Medialink Technology™ is now available for the P-1000 Series of amplifiers. The technology is capable of providing remote control and monitoring, and it works using either Windows or Macintosh computers. The monitoring and control functions include the ability to review the on/off status of each amplifier within a given system and adjust channel input and output levels, display the status of protective circuitry, mute specific channels, and reverse signal polarity.
Mfr: TOA Electronics
Price: depending on applications
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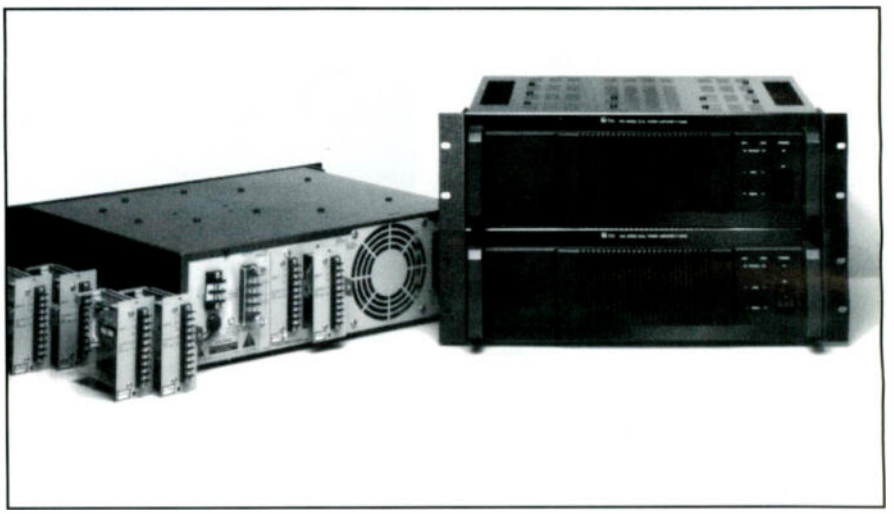

TRIAXIAL OUTDOOR SYSTEM

• Leviathan II is a fully horn-loaded, signal-aligned Wavefront triaxial device. The system utilizes radical-scale technology to solve acoustical problems associated with large environments. The low end employs six Ferro-fluid cooled low-frequency drivers coupled to a fiberglass horn, The horn measures 84 inches from front to back and has a 72 by 72 inch mouth. Power handling is rated at 1,200 watts, and has a 90 by 90 degree pattern at 6 dB points. The system is matched with a coaxial mounted high-frequency and midrange horns. The dual-drive inner horn is covers 250 to 1,200 Hz 1000 to 10k from the inner horn. Fully weatherproof and capable of withstanding wind speeds in excess of 100 miles per hour, the system includes hanging brackets and a gasketed conduit box with a gland-nut entrance.
Mfr: Community Light & Sound
Price:
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COMPRESSOR/LIMITER

• Occupying only one unit of rack space, the DL441's features include, switchable hard/soft knee compression with ratio control in both modes, auto attack and release to constantly follow the dynamics of the signal and preserve transients while allowing excessive peaks to occur, peak level control, adjustable between 0 dB and +16 dB, utilizing Zero Time ResponseZero overshoot circuitry. The unit is switchable for +4 dBu or –10 dBu and uses balanced XLR inputs and outputs.
Mfr: QMI / Drawmer
Price:
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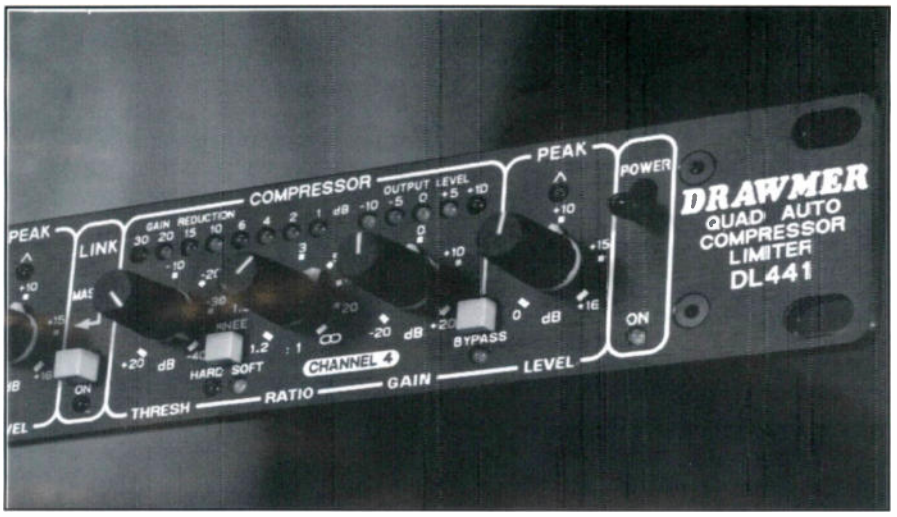

FIXED INSTALLATION SYSTEMS

• The MC-82, intended for vertical installations is 10-in by 10-in. by 26-in. high, while the MC-82H (shown here) is intended for horizontal installations such as under balconies, and is 10-in by 10-in by 30¼-in. wide. Both feature a line array design incorporating a constant beamwidth high-frequency horn (with a 1-in. compression driver) and is mounted between two high performance 8-in. woofers. They handle 200 watts power, deliver maximum SPL of 122 dB and provide 110 H by 70 W. A universal mounting hardware system, featuring twelve attachment points is included.
Mfr: Renkus-Heinz
Price:
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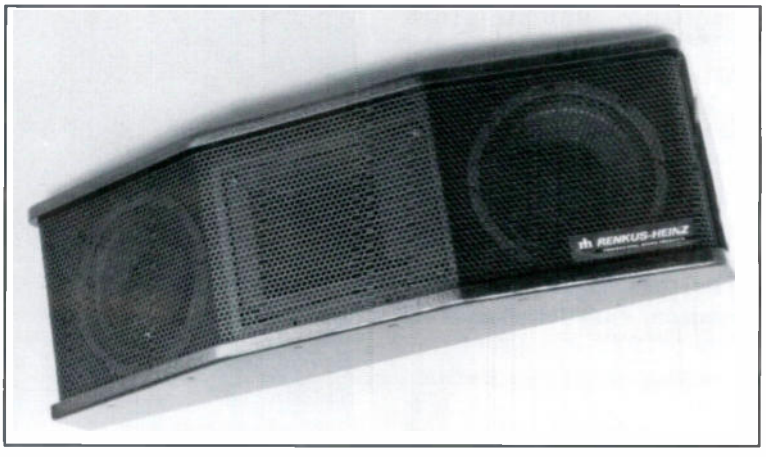
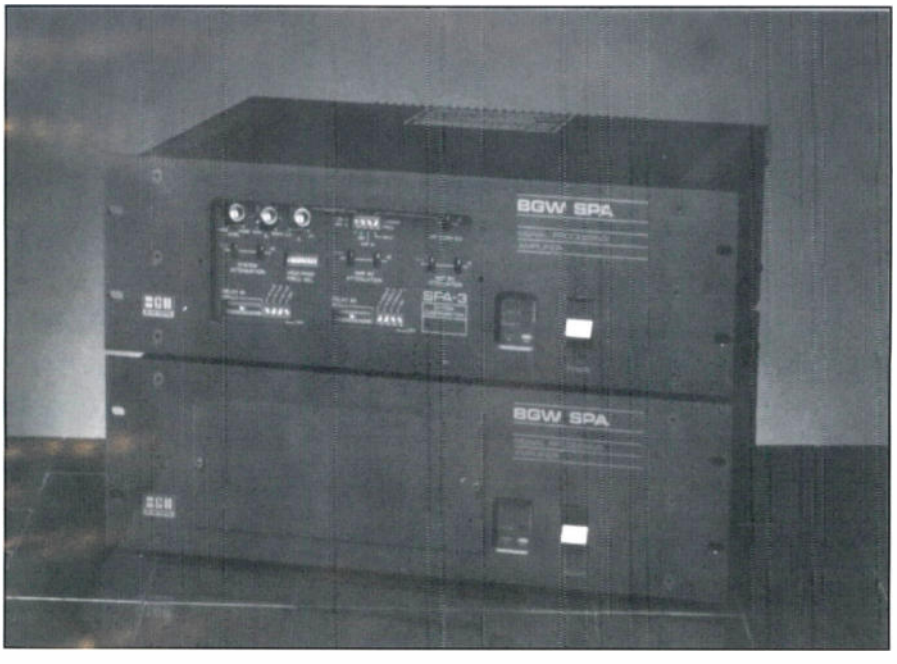


SIGNAL PROCESSINGAMP

• The SPA-2 includes to high-power amplifier channels. The signal-processing section consists of a customer specified tow-way crossover, one delay line, a sub-sonic filter, a compression-driver equalizer, a parametric equalizer, cinema screen compensation (if applicable). Power is 500 W per channel at 4 ohms, 300 watts at 8 ohms, crossover is a Linwitz-Riley 24 dB/octave or customer specified, the HF equalizer has 1 dB steps, the parametric adjusts frequency, amplitude and Q for one LF anomaly and the subsonic filter is switch selectable in 10 Hz increments from 10-80 Hz.
Mfr. BGW
Price: $2199.00
Circle 64 on Reader Service Card



STAGE MONITOR

• The low-profile èlite EX-350 stage monitor features a specially angled horn for better on-stage throw while allowing performers to show off their boot tops! This 350 W èlite has a 102 dB sensitivity from a 12-in driver-with-horn. The unusual cabinet design permits more units to be sued for a tight floor monitoring array. A specially-designed P-350 èlite processor may be used for optimum full-range sound or as a crossover with èlite sub woofers.

Mfr: Yorkville Sound
Price: $849.00
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MIC LINE

• A new mic line, designed for sound-reinforcement applications includes the subminiature AT933PM/ML, single goosenecks AT935AMR/C, /H, /ML, and double goosenecks AT915QMR/C, /H, ML; AT915AMR/C, /H/ and /ML. TheAT935 series feature interchaneable elements, integral power module thread-adapter mount or XLR quick mount and shock mount flange. The AT915 double goosnecks offer identical characteristics as above. The AT933 series features are also similar and feature either ceiling-plate or in-line power modules The AT845R/RW and AT847/RW remote powered units are boundary mics. Both accept 9V to 52V phantom power operation.

Mfr. Audio Techica US
Price: depending on model
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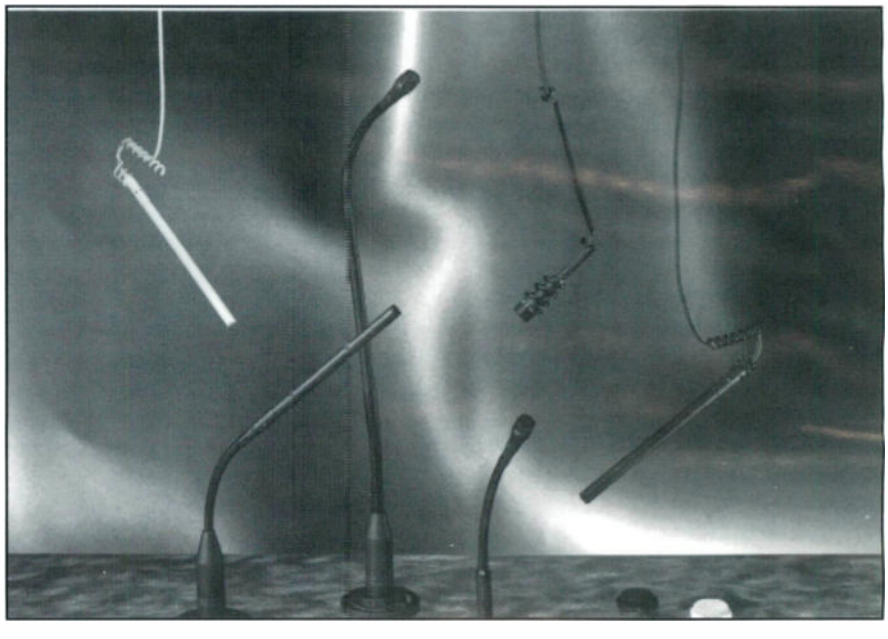


New Products are edited from information supplied by the manufacturer. The Reader Service Number under each product is computer processed when received and sent to the respective manufacturers who, in turn, send out the information.

If you are a manufacturer and want your new product listed in this section, send the release, include the suggested list and there must be a photo or diagram included.

Send to New Products Department, db Magazine, 203 Commack Road, Suite 1010, Commack NY 11725.

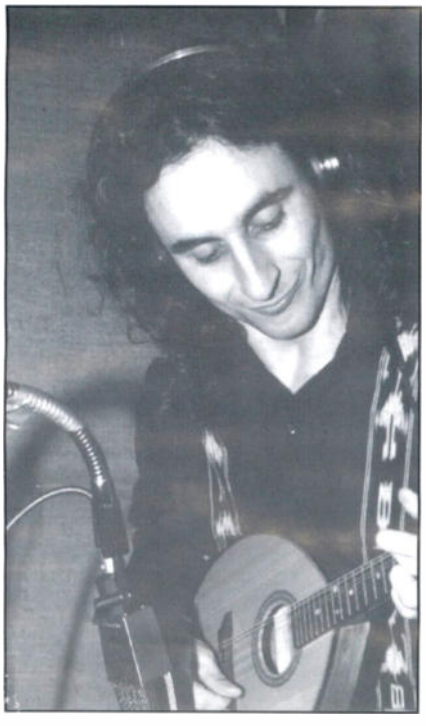
JOHN BARILLA

THE ELECTRONIC COTTAGE

Photo Opportunities In The Studio

● As a producer/engineer who plies his trade in the world of contemporary pop music, I confess that much of what I do has become routine to me. The relentless beat, the awesome drums, the dogged synchronically of computer-controlled music—these celebrated marks of a hook-laden record are all too easy to achieve with today's technology. Because of this technology, we often end up reducing music to a compilation of data rather than a performance that needs to be captured. The result of this can be sonically brilliant, yet creatively quite sterile.

Figure 1. Gene Koebler rehearses in John Barrila's studio.



Every once in while, though, I get to work with a musical artist whose natural inclinations is contrary to prevailing trends; someone whose musical ideas are so spontaneous that I am challenged both creatively and technically. Such a person is Gene Koebler, whose musical palette ranges from the heaviest rock to acoustic folk to quasi-New Age. Words are poor here to describe the intense individuality of his music; in reality it transcends all the categories mentioned, but those categories are useful in pointing to the kind of dynamic we are trying to capture on tape. There is no cruising gear allowed, no comfortable lapse into formula here; there is just the sheer outpouring of Koebler's creative energy, buffered, directed and amplified by my skills as producer.

UNDERLYING PHILOSOPHY

This project, Koebler's second album, is exciting to work on for a number of reasons. One reason is that we are using a production methodology that marries MIDI recording and acoustical recording in a totally natural way. While many musical projects today involve samplers, synths and computers, most of them also rely heavily on the process of *quantization*—which means having the computer alter the timing of the actual performance to fit with its own internal clock. What usually results is a picture-perfect track in which all the nuances of individuality have been neatly ironed out. When quantization is fully implemented, every note intended to come in on the first beat of a musical phrase comes in precisely on the first beat—not a millisecond earlier or later. This power to bring all performance into such radical uniformity with just a few keystrokes on the computer is a temptation that is difficult for most people to pass up. After all, it does make the playing sound tighter and punchier than it actually is. Since virtually everybody else is playing to that standard of precision, why not avail yourself of it? Well, one good reason is that "real" musicians do not conform to such an arbitrary standard. Their performances are always within a certain specification that we call "professional," but they are not rigid. Gene Koebler wanted this realism in his tracks, so any MIDI performances were done "au natural"—in real-time, with all the nuances left in tact.

While some of Koebler's pieces use strictly acoustical and electric instruments, typically the process would start in his own pre-production studio—a true *Electronic Cottage* remotely situated on a secluded estate. There he would usually record bass, drums and grand piano using sampled sounds from his collection of MIDI modules. To enhance the realism of the performances, Koebler played all the drum parts using a MIDI drum kit. Composed of various foot pedals and drum pads, the drum kit triggered an Alesis D-4 sampled drum module giving him the best of both worlds: realistic performance coupled with the hottest digi-

tally recorded drum sounds. After he had finished these underlying rhythm tracks in his own studio, we transferred them to my multitrack machine and proceeded to do all the acoustical overdubs and mixing at my studio. This is where the fun began!

IN THE STUDIO

An expert string player, Koebler plays multiple instruments in that family of instruments, and we used many of them in this recording: 6-string and 12-string acoustical guitars, mandolin, dobro, dulcimer and also electric 6- and 12-string guitars, and fret-less bass. There was also lots of hand percussion—some of which was fairly exotic in nature—as well as wood and metal flutes. I experimented a bit on mic'ing arrangements using two and sometimes three mics on the acoustical instruments. The location and choice of microphone were based on the nature of the instrument. In general, however (in the case of acoustical stringed instruments) we ended up with two mics in tight—one at the bridge, one near the neck. In the control room, I played with the relative volumes of each mic until I got the most flattering blend. These two inputs were also compressed and subtly processed through an Aphex Aural exciter, which helped to bring out the characteristic individuality of the instruments. Finally, to even out the frequency response of the neck, I used equalization and a BBE Sonic Enhancer. The entire microphone chain was followed by a single-ended noise filter to keep everything nice and quiet. Interestly, some of the instruments benefited by configuring the mics in a stereo-panning arrangement, but some did not.

My conclusion is, the bigger the instrument, the better it sounds in stereo. In other words, the big-box Martin guitar sounded best spread out, while the mandolin sounded best when both input channels were collapsed into mono and panned to one side in the mix.

PHOTO OPPORTUNITIES

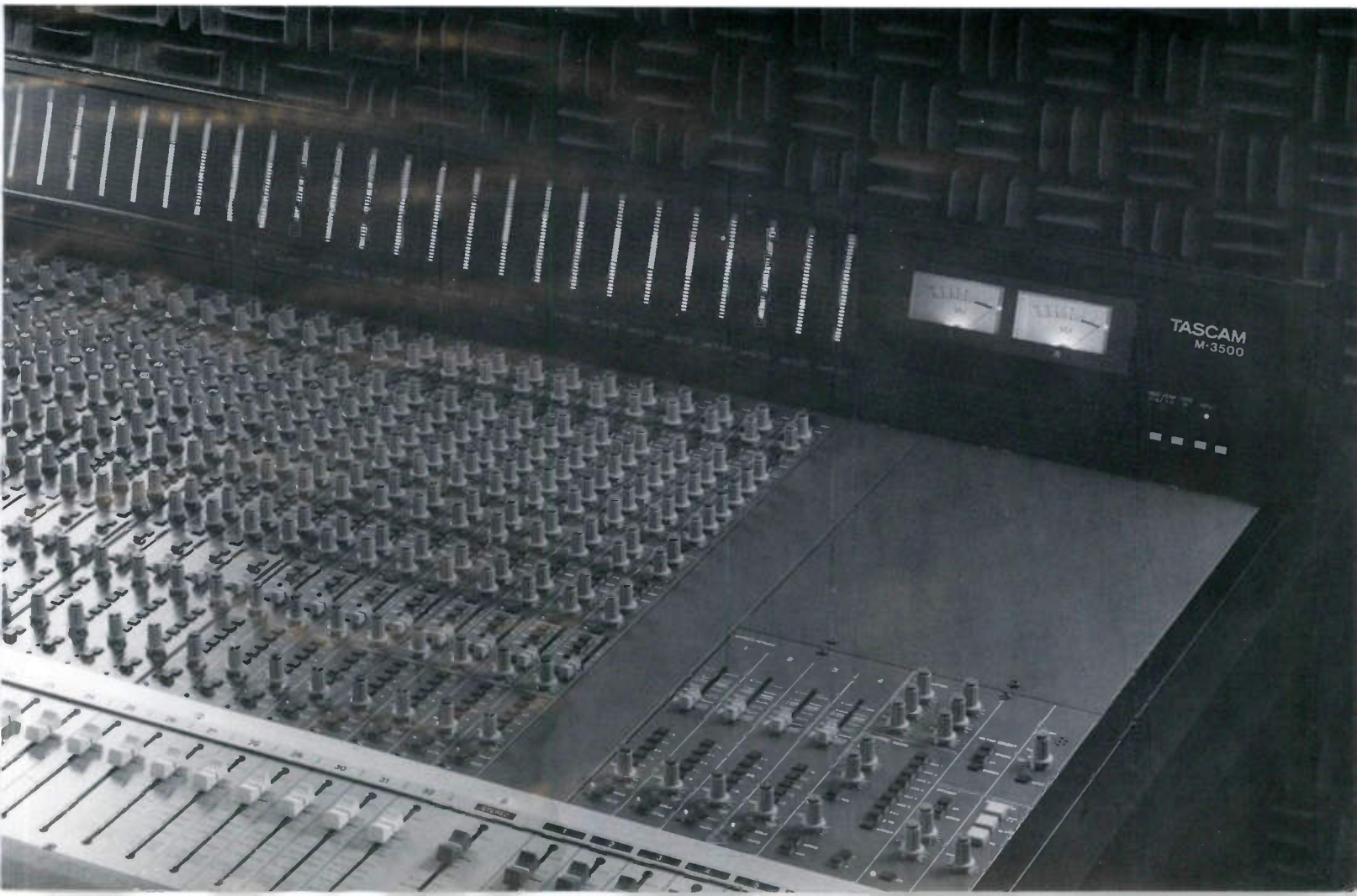
Unless your camera is close at hand you may miss many a photo opportunity. The same holds true when recording a spontaneous, intuitive performer like Gene Koebler. As engineer, I cannot be so absorbed in getting a good sound that I fail to record a great performance. While he is usually quite definite as to his basic rhythm tracks and lead vocal melody, everything else for Koebler is a completely open book. Since he has such a well-spring of ideas, I find it best to let him experiment for a while (in front of an open microphone, of course) and call him in for a listen, when I feel things are beginning to gel. The photo analogy holds here too: what I do is simply shoot a whole role of film and hope for one great shot. With Koebler there is always an inspired performance for every track he lays down. Sometimes it occurs after repeated takes, but other times it's the first attempt that is golden. It's impor-

Figure 2. Gene Koebler adding vocals. Note the mic outline barely visible behind the screen.

tant to be able to recognize the definitive performance when you hear it, and not keep working it into the ground. By knowing exactly when to say, "Stop, that's a take," the freshness of the performance can be preserved.

Some interesting anecdotes from these sessions will serve to show the degree to which spontaneity was overtly cultivated. Having recorded Koebler many times, I noticed that he had an interesting idiosyncrasy. Whenever he sang or played his instruments, he would clamp his teeth together in rhythm with the music. (It reminded me initially of jazz pianist Erroll Garner's well-known grunt). In most of Koebler's songs, this artifact was well covered by the instrumental music, so it went unnoticed. At one point, however, we were recording a quiet passage in a song and there was this very audible chomping sound between the lyrics that sounded much like a cross between temple blocks (or some such wooden percussion instrument) and castanets. I brought him into the control room, played back his vocal in solo mode, and we all had a good belly laugh. But after the levity had subsided I started thinking, "Hey, why not use this unique sound deliberately in the song?" The intro and outro of the song in question was a highly image-filled passage and his chomping sounded a bit like a lady with stiletto heels walking across a hardwood floor. So we recorded two tracks of nothing more than his rhythmically clacking teeth and panned them left and right in the mix. The result was an extremely evocative percussion track that could not have been better performed on any known instrument. And so the art of "dental percussion" was born!

On another occasion Koebler asked me if I had any bongo drums that he could play. I did have a set of bongos, but one head was torn. We didn't want a sophisticated MIDI sampled sound, but rather the simple, primitive sound of the human hand slapping a real object. At that point, we were grasping at straws, but Koebler started tap-



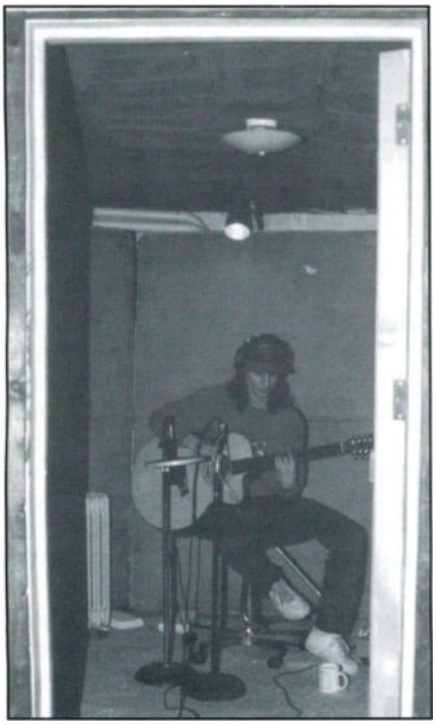


Figure 3. Recording guitar in Barilla's islolation room.

ping the rhythm on the back of one of his acoustical guitars and it sounded interesting. So he placed the guitar upside down across his lap (in order to keep the strings from ringing) and I pointed two mics—one at the head, one at the tail of the guitar and retreated into the control room. After a whole lot of bizarre EQ'ing, I managed to get these slaps to sound a whole lot like Indian tabla drums. And so, we ended up using this technique several times during the recording sessions.

Perhaps the most unusual example of what has been called "found percussion" is another anatomical device we dubbed the "nasal shaker." Another fortuitous accident brought this to light. While cutting some vocal harmonies, Koebler mentioned that he'd like to put a shaker part in the song, but alas, there was no shaker in the house. Kidding around, he started to imitate the shaker sound by snorting out a rhythm. Of course he was only kidding, but on my side of the glass I saw it as another photo opportunity that should not be missed. So I asked him to keep on snorting while I hyper-compressed the sound and brought out the scratchiness with some intense blend EQ. I asked him to perform the whole passage (which was pretty lengthy for a guy hyper-ventilating 16th note triplets), but it worked. Despite the comical nature of the performance, Koebler's work is serious art, and touches like these lend another unique mark to a very personalized recording.

The moral of this story for engineers and producers is clear: Don't waste too much time seeking an artificial standard of recording perfection. Sometimes the greater skill is in seizing the moment before it fades forever. A timeless moment captured on film may captivate the minds and hearts of millions; and even though it might be slightly out of focus, no one will know or care. Likewise, in the recording studio photo opportunities come and go. Don't miss the next one that comes your way. db

1993 Editorial Calendar

JAN/FEB *The Electronic Cottage and Project Studios.*

Winter NAMM Show issue.
• GUIDE: Speakers: Performance & Monitor.

MAR/APR Radio and TV Audio/Sound Reinforcement in Permanent Installations.

NSCA & NAB show issue.
• **GUIDE: Consoles and Mixers, Work Stations.**

MAY/JUNE *db Visits Houses of Worship.*

• **GUIDE: Power Amplifiers.**

JULY/AUG Live Sound—Intimate Clubs to Major Stadiums.

• **GUIDE: Tape, Tape Recorders and Accessories, Microphones.**

SEPT/OCT *State of the Recording Art.*

AES in New York Show issue.
• **GUIDE: Signal Processing Equipment, Part I, (delays, reverbs, crossovers, equalizers).**

NOV/DEC *Post Production—Coast to Coast.*

SMPTE in LA Show issue.
• **GUIDE: Signal Processing Equipment, Part II, (noise gates, noise reduction, limiters, compressors).**

NAMM—Jan 15-18 (Anaheim)

NAB—April 18-22 (Las Vegas)

NSCA—April 2-4 (Orlando)

AES—October 1 2-Nov 2 (New York)

SMPTE—October 30-Nov 2 (LA)

NAMM—1994 Jan 21-24 (Anaheim)

RANDOLPH P. SAVICKY

Audio, Video, Stage & Lodging All Under One Roof

Kampo Cultural & Multi-Media Center: Downtown New York's Home For Local & International Commercial Professionals & Multi-Disciplinary Artists.

MULTIMEDIA, THE MERGING of digital video, high-quality audio, and computer graphics, is considered one of the most exciting and dynamic industries of the '90s. Today, many companies are jockeying for position to take optimum advantage of the synergism offered by multimedia, and many recording studio owners are among those pondering their next move.

One studio in New York City, Kampo Cultural & Multi-Media Center, has already anticipated this merging of technologies. Over the past decade, Kampo has earned a world-wide reputation as a multimedia facility for both local and international commercial professionals and multi-disciplinary artists.

THE BUILDING

Filling a six-story cast iron building off Broadway in Noho, Kampo Center features a complete multimedia facility all under one roof. This includes one-inch on-line and three-quarter-inch off-line video post-production suites with a separate voice-over booth, a 24-track audio recording studio, and Kampo Hall, a 1,100 square foot multipurpose live performance and production space.

Two additional floors at Kampo Center are available for film, video, and photography productions, art exhibitions, workshops, receptions, and overnight accommodations.

"We feel that New York City is a microcosm of the world, and Kampo Center embraces the cultural and artistic diversity of the city's international community," explained Gabrielle Riera, Director of Kampo Center. "Fundamentally, we are a cultural center that has continued to thrive because we can accommodate our commercial clientele successfully.

"As a totally integrated facility, Kampo Center provides both artists and corporate clients with the technology, services, and education to realize their creative and commercial goals," she continued. "We want them to be able to present their vision or their message to the world in the best way possible. Yet, at the same time, we're small enough to be personally attentive to all of our clients' needs."

RECENT WORK

Kampo's ability to provide multimedia technology while offering quality service and personal attention at affordable rates has attracted an impressive and wide range of clients over the past year.

Commercial work thrives at Kampo Center as well.

Major label recording artists like Al DiMeola, Dr. John, Al Grey, and Poster Children have recorded in the audio studio. The New York-Buenos Aires Connection's debut Compact Disc, "The New Tango," which was recorded and mixed at Kampo, was voted among the "Ten Best Releases" of 1992 by the listeners of WNYC's "New Sounds."

Professional dancer, teacher, and renowned hip hop artist Roger G recently completed postproduction of "Hip Hop With Roger G," an instructional workout video produced by Kampo Center Productions.

George Benson, Patti Austin, and the Harlem Boys Choir have also filmed music videos in Kampo Hall.

The Black Leadership Commission On AIDS (BLCA) produced "Choose Life," a 12- part cable television series at Kampo Center. "Choose Life" is designed as a learning tool for viewers to gain knowledge, information, ideas, and methods for promoting AIDS education and prevention in the African-American community across the nation. Emmy Award-winner Cliff Frazier supervised the four days of production.

In addition, a sound-for-film project was recorded by the 26-piece Walter Thompson Orchestra for David Hannah Productions and soundtracks for two films were recorded by Deep Creek Productions at Kampo Center. One of its films, "Wedding Banquet," won the first prize "Golden Bear" at the 1992 Berlin Film Festival.

Commercial work thrives at Kampo Center as well. Pepsi, Bryant Air- Conditioning, House Of Seagram, and other major corporations have completed commercial projects in Kampo's audio and video studios.

Production companies like S.A.B. Productions, Tonal Images, and Conner & Company Filmworks have used the Kampo facilities to produce "I Am Every

Randolph P. Savicky is President of RPS Communications, Centerport, NY, a public relations and marketing company specializing in the professional audio, video, broadcast, and music industries

Figure 1. The Kampo Audio Live Room

Woman," a documentary on Whitney Houston, and "I Have Nothing," Houston's recent music video, "Nicktoons" for Nickelodeon, "Kiko And The Lavender Moon," a song by Los Lobos which was nominated for a Grammy Award, and the sales video for "Handel's Messiah: A Soulful Celebration," whose artists won a Grammy for "Best Contemporary Soul Gospel Album."

The facilities offered by Kampo Hall have attracted professional theater groups such as Signature Theatre Company, which recently announced its third year of residency at Kampo. Signature just completed its second season working with Lee Blessing (author of "A Walk In The Woods"), as its playwright-in- residence, and welcomes Pulitzer Prize winner Edward Albee as its playwright-in-residence for the 1993-94 season. Productions of Signature have been reviewed in publications ranging from the New York Times and Time Magazine to the Times Of India.

To meet the needs of such a diverse client base, Kampo offers a full array of video and audio equipment. The video suite includes a CMX 3500 computerized edit controller, Grass Valley 100 SEG, Sony one-inch recorder, Sony three- quarter-inch SP edit recorders, Sony Betacam SP edit recorders, and Sony VHS recorders. A recent addition is the Amiga 2000/NewTek Video Toaster with digital video effects. The video facilities also house a voice-over booth and three-quarter-inch off-line editing room.

AUDIO EQUIPMENT

The audio recording studio features a Solid State Logic 4044 E Series Console with G Series Computer and Total Recall, Studer A-820 24-track recorder, Ampex quarter-inch, Otari half-inch, and Panasonic Digital Audio Tape (DAT) recorders, a complete Adams-Smith 2600 synchronizer rack (three machine lock-to-picture, one-inch layback), Steinway B piano, full selection of outboard gear and microphones, and a MIDI rack.

"If any of our clients have any special requests for equipment that is not provided in-house, we will make sure that the equipment is available for them," said Riera.

Kampo has become the choice of artists recording audio and video productions because of its multimedia network capability. Simultaneous communication is available between Kampo Hall, the video editing suite, and the audio recording studio (including 24 tracks of audio, program video, time code, house sync, and RTS intercom). The network enables Kampo to simultaneously record and video tape live performances.

For example, the Thomas Chapin Trio and Zasis Improvisatory Ensemble reaped the benefits of this unique aspect of the Center by recording and video taping their concerts live.

"The arts are essential to our well-being because they nourish the human spirit,..."

Balancing its role as both a cultural and multimedia center, Kampo also offers a wide range of classes. These include Japanese language, calligraphy, brush painting, Butoh dance, Aikido martial arts, yoga, theater, Haitian dance, and Shamanic workshops. Some of the multimedia classes at Kampo Center include CMX video on-line editing and the NewTek Video Toaster, as well as audio classes on the Solid State Logic recording console.

THE REASON FOR KAMPO

Kampo Center was founded in the early 1970s by Kampo Harada, a master calligrapher and teacher in Japan for more than 40 years. In 1953, Kampo, who is also known as Soshi or Grand Master, founded the Japan Calligraphy Education Federation, which currently has 700,000 students worldwide.

As a promoter of international cultural exchange, Soshi established Kampo Center in New York to foster intercultural awareness by supporting both the traditional and the experimental arts, including theater, music, dance performances and workshops, exhibitions, and other special events. The multimedia facilities at Kampo are designed to support this awareness.

"The arts are essential to our well-being because they nourish the human spirit," said Riera. "The arts transcend cultural barriers

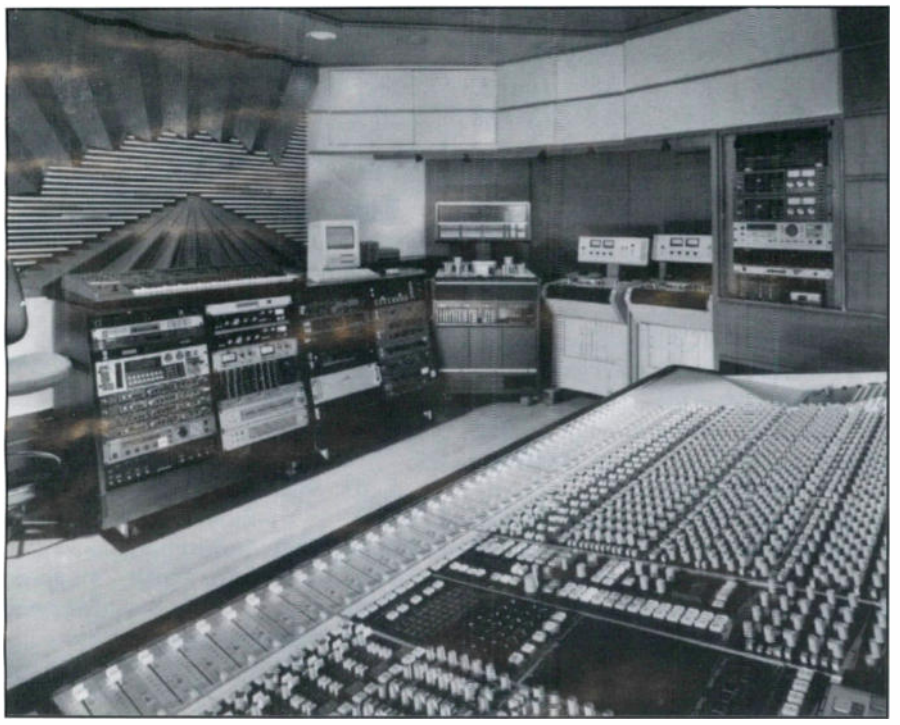


Figure 2. Audio Control.

and bring people together. At Kampo, we feel that it is important to provide a multimedia venue for the creative and artistic expression of people from different cultural backgrounds."

Kampo Cultural & Multi-Media Center: Client List

Recording Artists:

Al DiMeola Al Grey Anton Fig Danny Gottlieb Deborah Harry Dr. John George Benson Harlem Boys Choir Jose Feliciano Larry Coryell New York-Buenos Aires Connection Patti Austin Poster Children Teruo Nakamura Warrior Soul

Production: Agencies/Producers/Directors

Adam Dubin Productions Bill Graham Productions Conner & Company Creative Music Concepts Deep Creek Productions Dick Scott Entertainment Doghead Films Envy Music Lenny Grodin Productions Black Market Productions Mustapha Khan Partnership Works Platinum Vibe Rocking Horse Filmworks SAB Productions Tonal Images Vinnie Giordano Productions Zack Smith Music

Audio Department 24-track audio recording studio with 21 foot x 28 foot live area, 11 foot x 11 foot isolation booth, and artist/producer's lounge with complete home entertainment system.

Record Companies: Atlantic Records Chemistry/Mercury Records Columbia Records EMI Records Geffen Records Hollywood Records IRS Records Pow Wow Records Relativity Records Savoy/Malaco Records Sire/Warner Bros. Sony Music Tee Vee Toons

Radio & TV Commercials

Bryant Air-Conditioning Coca-Cola Nick Toons Pepsi-Cola House of Seagram

Figure 3. The Video On-Line Room at Kampo.

THE KAMPO LAYOUT

Kampo Cultural & Multi-Media Center: Facilities

First Floor

Production Studio: The multipurpose production studio (dimensions: 21 feet x 54 feet with a ceiling height of 14 feet) is wired for multiple cameras, 32 microphones, 24 tracks of audio, time code, house sync, program video, program audio, and RTS intercom, and connects to the editing suite — with

splits to the audio control room and a mezzanine control room/projection booth—for a variety of fully integrated recording situations. This studio is temperature-controlled, soundproof, and includes a 12 dimmer theatrical lighting package and dressing rooms. Multi-camera studio production packages are also available.

Second Floor

Audio Department: 24-track audio recording studio with 21 foot x 28 foot live area, 11 foot x 11 foot isolation booth, and artist/producer's lounge with complete home entertainment system.

Equipment: Solid State Logic 4044 E Series Console with G Series Computer and Total Recall; Studer A-820 24-track recorder, Ampex quarter-inch, Otari half-inch, and Panasonic Digital Audio Tape (DAT) recorders; Steinway B piano; full selection of outboard gear, microphones, and MIDI rack (Akai S1100 sampler/Mac SE, etc.)

Third Floor

Video Department: One-inch on-line and three-quarter-inch off-line video editing suites and voice-over booth.

Equipment: CMX 3500 computerized edit controller; Grass Valley 100 SEG with AMS- 100 audio follow video option; Sony BVH-2000 one-inch recorder, Sony BVU-850 SP three-quarter-inch edit recorder; Sony BVW-40 Betacam edit recorder; Sony PVW- 2650 with DT player; Sony PVW-2800 edit recorder; Sony SVO-16 VHS recorder; Amiga 2000/NewTek Video Toaster with Lightwave 3D animation, character generator, Toaster paint, dual frame buffers, chroma FX color processor, frame grabber, and digital video effects.

Fourth Floor

Loft Space: Traditional Japanese tatami room, hardwood floors, and exposed brick combined with PA system, TV monitor, and videocassette recorder. Designed for classes, conferences, workshops, and multi-media productions.

Fifth Floor

Loft Space: Newly renovated 2,400 square foot space with hardwood floors, a kitchen, and two bathrooms, and with sleeping quarters in the rear. It is designed for film, video, photography shoots, and receptions. db

LARRY ZIDE

Masterdisk, Re-Visited

Masterdisk of New York City is one of the venerable mastering houses in the U.S. Years ago, we did a story on the then-new direct metal mastering of LP records. There have been changes in the industry since then and changes at Masterdisk, so we thought it appropriate to schedule a re-visit.

WE DECIDED TO INTERVIEW at least two of their mastering engineers and it was decided that it would be both Scott Hull and Tony Dawsey. First we spoke with **Tony Dawsey**.

We first asked Tony what he does with a recording as it first comes in.

Began Tony, "Well to start off with I'll say that when I get a tape from any mixing studio engineer, I feel that what they have on the tape is basically what they want. So when I play the tape back here, whether it's half inch, quarter inch, DAT, 1630, in listening to the material, I decide then which analog to digital converter I feel is necessary to benefit the project. There are several different ones we have here, the Pygmy, the Wadia, the Apogee, etc. It's at that point I decide what I feel is best for that, depending on the music, its dynamic range, and so forth.

"They have their limitations, there are certain things I like more about some than others depending on the project, and what type of music is, I'll decide then. I don't want to give out my secrets, so to speak, as to what type of music I'll use whatever converter with, but that's basically how I do it here. A lot of people I work with may have a tape coming in on DAT but it doesn't necessarily mean that they want to stick to the digital domain. A lot of people like the big analog sound that I achieve with various equalizers on my console, my experience with it. If the client wants to use the digital equalizer that's no problem I'm more than happy and willing to do that, but that's another decision that you have to use right at the start of the session."

Then we asked just how these do you find that clients come in knowing what they want or do you have to guide them along to what's available and what kind of choices that can be made?

Said Tony, "I think sometimes people have an idea of what they want, and other times they leave it up to you, you're the engineer they feel they trust you, so on and so forth. I'll decide then myself, for the most part, normally I don't have people asking me what A to D converter you are going to use, or are we going to stick in the digital domain, or whatever. People just don't do that. I think that your reputation speaks for itself, and people come to work with you for that. They know that you are going to do the best possible thing you can to improve and make their project as good as it can be.

"People are a lot more laid back at this part of the mastering stage, because you have to go through the initial recording which could be twenty four, forty eight or whatever many tracks. After that you mix down on to two tracks, whatever format, and when they come in here, this is what we got and we'd like you to do the best that you possibly can. I don't feel like people pressure you into using anything. They leave it up to you, basically. A lot of clients are familiar with all the different type of converters, and they may comment on one in particular, but for the most part, people leave it up to me."

We now asked, if most of the work you're doing ending up as CD's or as cassette, or is there still a lot of LP production?

Said Tony, "I don't think there is a lot of LP production, that's really cut down a lot over the years, but just about everything is going to get on CD or a cassette these days, that's standard. I do a lot of different twelve inch type of records, dance, raps, that I always cut vinyl for, but the LP has kind of died out over the years. Cassettes and compact disks are the main thing that we end up making."

Our next question was, what can an incoming client do on his tape, that he brings to you, to make it easier for you?

"I just think that hopefully it's recorded well from the start, and then it's mixed down properly and if you could just make it the best you possibly can in each stage, then that'll make my job a lot easier. Once in a while you do get a tape in here that's done so well that you barely have to do anything to it, where other tapes need a lot of work, a lot of EQ to make them sound very good. It really varies from engineer styles though. A lot of different things account to how a tape sounds. I would just recommend that people get it as well as possible. Try to fix whatever problems that might be there before they come here. Sometimes you have to fix problems here, but, hopefully, you don't have to end up doing that," said Tony.

WHAT EQUIPMENT IS USED?

We now wanted to know about some of the equipment that you are actually working with to produce this final CD or cassette master?

Tony replied, "Again, you have a choice when you come here. You can either stay in the digital domain, if you have a DAT or a sixteen thirty tape or if your tape is half inch or quarter inch analog, you use analog EQ. So you have a choice right there. I use standard

Neumann equipment with Sound Tech equalizers, and NTP compressors and a few other little goodies on the console that I combine to give a nice big analog sound that a lot of the clients like. Other than that, in the digital domain I have a *Harmonia Mundi* digital equalizer with a de-esser, compressors and other different characteristics.

"There's a lot of different types of digital equalizers, lots of different types. We have a Neve here in one room, which is a totally automated console. The *Harmonia Mundi,* Sony; a lot of different people make different digital equalizers. I really like a lot the *Harmonia Mundi* because of the digital de-essing capability. A lot of people don't tend to de-ess a record in the studio because they want things very bright sound. A lot of people have a fear that by de-essing it you may have taken off too much high end. So a lot of times, by the time I'm finished equalizing the record, trying to make it sound right, if someone sings or talks with that *esss*, it just gets a little worse. So using this *Harmonia Mundi* digital equalizer takes a little bit of that off, so that the cassettes don't distort. That's just another creative thing again, it's something you have to decide when you're doing the session and working on the project."

NEW PROJECTS

Now, we asked Tony, what have you recently been working on?

"Something I've done recently that I'm crazy about that I think is going to be a big project, is a gentleman named *Guru*. He's one of the rappers with *Gangstar*. He recently collaborated with an array of different jazz musicians and what he's done is combined hip-hop or rap and jazz together. I'm just very, very excited about this project. He's just incredible. Bradford Marsalis is on it, Lottius Smith, just all kinds of people. He recorded this project all over the world, some in Europe, some in California, some here in New York. He had to travel to get with these different musicians and fingers on the project. So the format that he chose to go to was a DAT. So from all these different studios, I believe, if I'm not mistaken, there must be a good twelve to fourteen cuts on the album. Again, different artists, musicians and recorded everywhere.

Figure 1. Tony's room at Masterdisk. Most of the rooms are similarly equipped.

"The whole work was done all over the world and various countries. So he chose to use a DAT, so he comes in and he has a whole lot of DATs; so right there I play back, perhaps on a Panasonic 3700, and just see what it sounds like. And at that point I just start feeling, based on what he has on the tape what converter I feel would be best used for that. In talking with him, he wasn't really into using digital EQ, says he'll leave that up to me to do what I felt was best. I chose analog EQ being that I know the type of sound that he likes and that he wants. So again, I use my equipment on my analog console and after you equalize it you both agree on how it sounds. You end up transferring that using one of the different analog-to-digital converters and from there on to 1630 tape. At that point, after you've transferred each and every cut from all these different DATs and a whole lot of different EQ settings, you end up sequencing the tape. I have a Sony digital editor in my room, which uses three-quarter-inch video tape. So from there I sequenced the tape, we put it in the running order that he wants it, we get the spacing between songs. and you compile it. After that's done then he'll tell you 'I want five DATs' or whatever amount of cassettes, and you have to give the record company whatever they want. So from that EQ'd 1630 tape you run off all of their DATs or cassettes. At that point, once it goes onto the 1630 tape it stays in the digital domain using the Sony digital editor.

"Again, my attitude is whatever he has on that tape is the data that he wanted, basically. I'm just here to help it out, to make the transition from one cut to another as smooth as possible. You don't want some cuts louder than the next ones, you want to make the level even across the board, I would think they sound pretty consistent from cut to cut. It's not always the case, sometimes, it really depends what's on the tape originally itself. But it does sound consistent from cut to cut throughout the album."

We wanted to then know what has to be done differently, when you know it's going to vinyl, rather than going to stay in a digital domain as a final master?

Tony answer, "If you had a cut on the inner band, meaning the end of the record that had a lot of high end, you'd have to be careful not to put too much high end there or you

Figure 2. Tony Dawsey.

might get inner band distortion. Sometimes you have to compensate either by de-essing or having a lower level as you got in toward the center grooves. With a compact disk you don't have that type of problem."

Continuing in this vein we asked if, for example, a sound from a synthesizer—which is very deep bass heavy, would present serious problems trying to cut it on an LP?

"I wouldn't say that entirely, what I would have to do is some test cuts. I think the engineer, if he has any cutting experience, if on the inner bands something like what you just said happened, you would do a test cut and know that whatever level you could get away with playing it, playing back clean. Of course, like you said, on the compact disk you don't have that problem, but when it comes to vinyl you just have to make a test cut of that first. Sometimes you may have to do a little EQ adjustment but, hopefully, not. You don't want to do that, because you want everything sounding similar.

"We probably would end up cutting a project like that on DMM, and it's just an incredible piece of machinery where it works a lot better than, say the first ten or twenty years of when an LP came out. So that type of machinery, again technology playing a major role here would probably have a better chance of playing that back without any complications, as opposed to the one in my room. So the technology does not stop in this business. Every year something new is coming out to make whatever better. I don't feel that you would have the problems that you did many, many years ago in dealing with something like that. Before we could say this is a major problem we would have to change the EQ, you definitely would have to do test cuts first and find out if it is, in fact, a problem, because it might not be, might not be."

We now would ask you if there is anything that you want to talk about at this point?

Responded Tony, "Just that, I guess I'm kind of from the old school. I believe in keeping it simple. You know I remember I have a favorite teacher who used to say 'kiss all the time' I'm sure you know all about that, keep it simple, stupid. That's how I try to approach the mastering from whatever type of music and artist I'm working with, just try and keep it simple. Just believe that, unless they tell me otherwise, that whatever they have on their tape is basically what they want and just try and do the best we can in working together. I become part of the team when a person comes in my studio and I just try and do whatever is necessary to make them happy and make the record sound good. Sometimes you have to work a little harder on some than you do on others, but that's just part of the business.

"It's never going to stop, and I think as long as people want to spend some money they'll have something for you to spend it on. I still think the top mastering studios will be around for a long time.

NOW WE TURN TO ENGINEER SCOTT HULL

We began by asking about a recently finished Bruce Springsteen album?

How did that work come in?

Scott said, "The project depends a whole lot on what they have done up to that point, obviously. In the case of the Springsteen stuff they hadn't been edited together yet, so we needed to take individual batches from the individual songs as they were mixed and assemble them. It came in on DAT.

These were Bob Clearmountain mixes that he did for the TV special. The CD wasn't of the entire show, so some songs were removed for flow and for other artistic reasons, some songs were moved around in the set because once they started removing songs then the set didn't work quite as well.

"Usually there are several numbers, in case of the *Paul McCartney Live* record we did a few years ago, and the case of Eric Clapton *Twenty four Nights* both of which were a number of years ago, there were multiple performances and in certain instances we took from some and from others and occasionally from sound check that had just been the best performance, because the actual performance had been flawed by technical difficulties, or whatever. In this instance there was just one performance, they had already picked their final versions of them, there were no studio fixes or overdubs on these tapes; these were raw mixes off the live multi-track masters. In other words, they had recorded live to multi-track on a twin 48-track Sony digital machine, and these were re-mixes of those tapes without any studio fixes or clean-ups

other than re-mix effects, and balancing. They had chosen all of their choice takes at that point and it had been clear to them why they could or couldn't use some of them. I believe Bruce did do a couple songs a second time at the end of the show, just to cover mistakes or cover eventualities. But I think for the most part they used the entire show as it went down. Actually, I don't recall if we even used any of the repeats, because all of the songs had the lead-ins and the lead-outs from the actual recording. What they had decided to do is not include a lot of the chatter that happened between the songs, so that meant finding ways of making it sound totally as if it hadn't been edited and that's always the goal with me."

We asked, just how do you do that?

"It's literally just as if a producer makes a band sound the way they're playing live in a studio, even though the tracks are recorded in different countries and different times of the year and different players. It takes quite a lot of work to find little pieces that you can fade into and cross fade out of, and make it sound as if you were really there. Technically, we use the Sonic Solution's editing system because it quickly gives me multitrack capability. It allows me to try a large number of editing choices and it's very high quality, so there isn't any degradation. It also give me very sophisticated EQ control in real time in a digital EQ control, so sometimes the end of one song an audience might be going *"vooo"* another time they're going *"heee"*, "Bruce" (there's a lot of "Bruce" on that particular show because audiences love to do for Bruce shows). What that EQ control allows me to do is match up audiences, fade one piece of audience into another piece of audience. It's not at all witchcraft, as really just trying to make from what is a very difficult environment, a nice controlled performance. At the end of a song a drummer might be, repositioning his kit, if it moved, or you hear a bass player slap his strings, and sometimes things get distracting when they get to hear them over and over again. So those things we might go after removing some of the chatter, the audience laughing to things that were happening on stage that you don't see because it's an audio production. A way you try not to include them is to find other pieces of audience, I almost always use audience from the same day and from the same show, because it's so much more consistent—it's amazing how different audiences can be from hall to hall. It's always a big challenge with them finding things because it was an international tour and we were mating up songs from one continent to another, and that became very difficult. In some cases we didn't even try to make it sound natural, we made it clear that it was the end of one segment and the beginning of another. In this case, it was a fairly long process of getting that all put together in a natural way with the way the artist wanted it done. Bruce wasn't able to be here, but his people were here and knew what he wanted, and that's how we proceeded from that point. He received a reference copy of that to approve or to make changes to."

Figure 3. Scott Hull.

Now, we asked, had you received DAT tapes from Springsteen's people? Is that the media you stayed with or did you convert them to something else in order to do your editing and assembly?

Scott explained, "Well, the Sonic Solutions is our disc editing system. So those are then transferred directly to digital, D to D as it's called; digital to digital transfer into the Sonic Solutions hard-disk editing system. It resided there almost throughout the duration, at least through all of the assembly and editing stages. Originals can come in directly via AES-EBU or Sony standard disc to disc interface. I've got a variety of ways I can get directly on and off Sonic.

ARE CONVERSIONS USEFUL?

Our follow up question, were they recorded at 44.1 or did you have to do conversions as well?

"No there weren't additional conversions, albeit the slight frequency response improvements at 48 k inevitably needs to be con-

verted. The Sonic has very high-quality converters built in with software that you can select on or off. As high tech as they are, they still do affect sound quality. I personally believe that a 44.1 kHz recording that is not converted, sounds better than a 48 k recording converted. Ultimately, you have to convert to 44.1 so I don't quite see the logic in recording at 48. If we had an extended bandwidth media to give to the public, I would probably be totally for a 24-bit 48 k type environment or something maybe that even exceeded that. But we don't. Conversion, to me, sounds worse than the small improvements that you get at 48k, answered Scott."

Now,did you end up doing a single CD out of this or were there multiple CDs because of the length of the concert?

Said Scott, "Single CD, that's part of what made the editing a little more challenging. The laser disk that had been released of the show was an entire, full length, I'm guessing now, about a twenty-song sort. I'm not sure, I don't have it in front of me. It was long, the entire show."

We inquired of Scott, now you have the entire pre-edited version of your songs in order and you're in the Sonic Solutions hard-disk editing system. Now you're applying within that system, some EQ and other controls. Are there also outside controls with which you might also be working?

Sott's reply, "For me, one of the small drawbacks of the Sonic system is that they are still working on the interface for the EQ. It sounds wonderful, but what happens is when I'm working with a client, it's not able to do always do exactly what I need it to do. Suffice it to say, I use outboard digital EQ almost exclusively when I'm not editing per se, or when I'm not assembling a piece together. So I might pre-EQ a piece of audience to insert it into the live performance or I might pre-phase a segment that needs to be cross edited into another segment. What's nice in the case of mastering is to assemble the entire show or assemble your entire master, because that's really what a job is. It is making it sound as if it's a continuous work, as well as making it sound pleasing to listen to from top to bottom. That in a big way, is what mastering is all about. If it was just a matter of equalization there's a wide variety of digital boxes that people can have in their small studios or in a back room at the studios. It's really a matter of the *creative* work of making it sound consistent. What I generally choose to do, and this depends project to project, is create one of two things. I'll either create a master, digital master, that's the entire show and then work off it, that'll either be DAT or 1630 U-Matic; or I'll work directly off the Sonic. That's a little more preferable."

Our next question. How much time can you put into the Sonic?

"As many disks as you want to add. I've got a little over four gigabytes of hard disk space, so I can run two large album projects concurrently on the disks. Even with this thing, with a whole bunch of alternate takes, and a long live performance, I still had some additional hard disk space. I don't have to re-create anything on the hard disk, this is what's nice on some of the better hard disk systems. It'll play back through my edit, literally, what a video house would call an edit decision list. It'll play back through that off of the hard disk in real time. I don't have to re-print that as a complete entity back to the hard drive. So, it allows me to stop and start anyplace in the selection, I can repeat that second chorus bit that I'm having trouble with EQ on, for instance, I can repeat that over and over quickly by just clicking on the keyboard. I'm not rewinding tape, that's what's great about random-access editing. It also makes a great playback format for the same reasons.

"At that point I ran the Springsteen digital audio through a portion of the Neve DTC, called *The Prism* which is an extended version of the Neve DTC 1. It's not stock equalization of a Neve DTC 1 prism system. They added a quite good sounding equalizer section that supersedes the original equalization. So I used that portion of the Neve and I also used the *Harmonia Mundi* digital equalizer all in series, but I was not utilizing every function of each. The reasons for that are: the Neve allows me plus/minus 1 or 2 dB in 1 dB increments at a wide variety of frequencies, but the *Harmonia Mundi* for the first few dB gives me half dB steps. If I'm stuck between whether or not to add any top, or add something in the mid-range or take something out of a bottom, I've got a choice of a 0.5 dB, 1 dB, 1.5 dB, 2 dB, or 2.5 dB while on the Neve it's 1 dB steps. As picky as that seems to sound, that can make a pretty big difference, just how much you want to remove.

"It's a creative decision. Each equalizer sounds a little different, as well. The *Harmonia Mundi* 's 1 dB at 4 k sounds different than the Neve's 1 dB at 4 k. Having to do with the shape and the way that they do the actual digital filtering."

WHEN YOU USE ONE OR THE OTHER.

This led to asking Scott if there are times when you would prefer to use one, and there are times when you would prefer to use the other?

Scott's answer, "Yeah, and quite often you've got a hunch about which one will work, but sometimes you end up surprising yourself by trying the other one and it sounds a little different, it's doing something a little different harmonically. Each song, each problem you address, you get a different response from it. You can only really go on the way it makes you feel, or the way it sounds. One dB, for instance, at a particular frequency on one device might sound more like two dB on another device, just because of the way they are affecting the material-that it's grabbing. Each device, correlates to analog. Massenberg EQ sounds different then an E-V EQ, or White EQ,. It correlates into analog as well. There's a different algorithm, a different way that they go about making the EQ. There are sonic differences among A-toD converters, as well.

"On analog-to-digital conversions from analog masters, even if you carry the project through an analog multi-track and analog console and analog two track, if you're going to release a CD, it's got to be converted to digital at some point. Actual choice of conversion can make a big difference on the way

the recording sounds. For example, here is a Elvis Costello release that we did just recently *Juliet Letters,* which was an analog master, analog multi-track and analog mix; a nice warm sounding piece, that didn't really need much in the way of mastering EQ. It sounded very good but, what became a critical decision is how you convert that Dolby SR ½-in. 30 in/sec tape to digital. We tried a number of different devices: Apogee converters, Pygmy converters, Wadia converters, Lexicon had sent us a prototype that was going to become their new device that's now out , one sounds a little richer and warmer, one had a little tighter bottom end, one had a little better extension in the top end and so something that's supposed to be as empirical as that conversion becomes an artistic decision. What's nice about that, is if you use the right converter for the project, you do less equalization in mastering. And that's a good thing."

Now our question is, you're going out of the Neve, or you're going out of the Sonic Solutions system to what, to actually make a CD master?

Scott's answer, "The ultimate format is a 1630 U-Matic tape. There's been some advances which are going beyond the experimentation stage at this point. Sonic Solutions is working with different CD manufacturing plants to enable mastering houses and CD manufacturing houses to actually use a CD as their master tape format. What this entails, is literally replacing the 1630 U-Matic tape with an *optical* CD, an optical write-once CD with appropriate information appended on it so that the CD manufacturing houses can play back from it. There are advantages; much lower maintenance cost, there's much less chance of a tape being damaged in shipping as a U-Matic tape can, digital error problems that come up when you are playing a tape back on a machine if the playback is on a machine that it wasn't recorded on, or differences between even identical machines, alignments and all that stuff goes away when you are talking about optical. That's a format of the future."

Our question, are you entering all the coding for the CD actually on the U-Matic?

Said Scott, "That's correct. Those can be critical production decisions, so we'll handle that here. Especially with a live performance, where does one song begin and where does it end? What we've do, is if a radio station is going to play back a cut (most radio stations set up their CD players or when they cart up their CD's, they set it up so when the track ends the song's done). In CD's there's a space between where the previous song and when the next song begins, it's called the *pause*. You have to utilize that to allow the DJ, or the listener at home, to when he cues up to track five, to actually cue the *beginning* of track five. But then when he plays track four it won't play through the space after track four or it won't play through all of the space between track four and track five. What it does is trying to make it useful for both radio stations to play tracks off, and for the music listener to have something to play interactively with. A lot of people love to re-sequence their CD's."

That should be really fun for you to do when you're dealing with a live concert tape.

"Well it's 'what's he saying here'? Is he talking about the previous song or is he introducing the next song and where is this going to be appropriate to make those breaks'. It's something not everybody realizes is as much of a production decision as it is. In a lot of cases they send the tape off to CD prep and the person who is doing that has to make a bunch of qualitative and artistic judgment calls about the piece of music. That's something the artist and producers need to really remain involved in, because it's all part of their production decisions. People are doing that more than they were, they're having fun with the CD format, now incorporating a bunch of different little tricks and different ways of hiding additional songs at the ends of CDs all sorts of fun and little fluff like that, I don't want to give them all away," said Scott.

Oh-give them all away (Both laugh)

"Well, the people will see on a particular disc where in the middle of silence at the end of the CD, the track numbers all of a sudden start incrementing, or jumping around. All of a sudden it will look like the CD player is losing its mind. And then after about a minute or so after, there will be a track, it's not listed on any of the label copy but it's something that the band wanted to include as a little special bonus for people to find if they left the CD running while they were doing dishes or something."

OK, Scott, another question, have I left anything out that you'd want to tell our readers on what it is you're doing?

Scott's answer, "What's become a big issue is mix-down format and mastering format. Analog vs. digital, analog-to-digital conversion, I already touched upon, but is a big issue. We're finding more projects come in on analog, but there's still a large proportion of them on digital. Some of those digital projects benefit from a transfer to a high-quality two track machine. That's been an occasional way of simply improving the emotion, the feel of the performance of the mixes. There is a wide variety of analog and digital gear out there that can produce some surprising results when it's out of its normal environment. Sometimes old tube gear or old analog equipment can add a real special sound to it, hopefully, without compromising the actual technical characteristics of it too much. People don't necessarily want technically-perfect stuff, they buy *music* and that's really the motivation. It needs to be the motivation.

"I've also been reading some of the hi-fi articles in which they don't realize what they're listening to. That's quite fine, a small little smirk or chuckle from me and that's the end of it. If they really believe that it sounds better because it was done all digital, then tremendous! I often say that I consider my job well done when nobody can notice that I was even there."

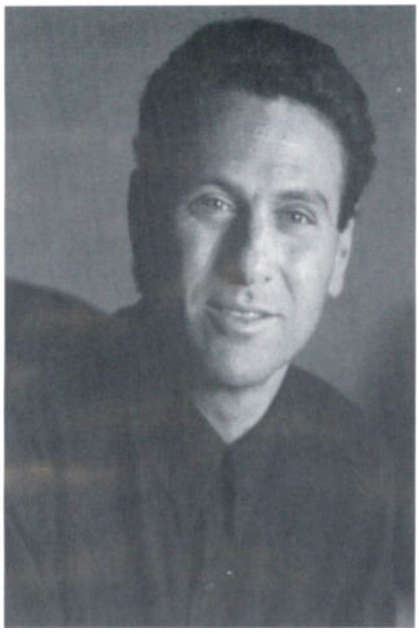


Figure 4. Doug Levine, President of Masterdisk.

Mastering technology is changing fast. We asked Douglas G. Levine, President of Maserdisk Corporation, To tell us just where he sees the mastering facility going and how he sees the process evolving?

● In my mind the answer to these questions starts with what will remain the same at the mastering facility and why master at a large multi-room facility such as Masterdisk. Whether working in the analog or digital domain; or producing CDs/cassettes/vinyl, the mastering house is your final opportunity for artistic input. Suddenly, after weeks or months of recording and mixing (it is rumored that Donald Fagen started recording his soon-to-be-released *Kamakiriad* engineered here by Scott Hull, over 5 years ago!) the day of reckoning comes.*Paranoia maxima* sets in; why did we mix on those monitors? or what were we thinking or drinking during the mix? This is the point where quality mastering is crucial to helping creative individuals maximize the impact of their work. Mastering is a highly specialized art involving but not limited to editing, sequencing, equilization , compression, and noise reduction. I would go to a dentist for a tooth ache, a cardiologist for heart pain and a mastering facility for *sonic relief.*

At Masterdisk we offer experienced and technically advanced engineers, state-of-the art equipment and a professional environment. Over the last decade we have seen the introduction of more formats and equipment than the previous history of recorded music. At last count, we offer at least five different A/D converters, which all have their unique attributes. As the technology boom continues the devoted mastering facility will remain vital. The producer or artist receives valuable and objective input from a mastering engineer who works on over a hundred projects per year. This 'fresh set of ears' is especially important after coming out of a project studio.

In this rapidly advancing world of robotics, virtual reality and interactive TV, it is refreshing that *over half of the sessions at Masterdisk are done on vintage analog gear*, although digital processing is available in all of our rooms. Many projects are mastered both analog and digitally or might require digital de-essing. At our facility one can find Ampex ATRs, over 20 years old or a Marantz DCC player, not yet out of the box !

Over the next 3 - 5 years there will be some changes or additions at the mastering facility; some of which are predictable and others less certain. Will DCC/Minidisk succeed in the consumer marketplace ? Minidisk would have very little impact on mastering, as compared to DCC which would require a $200,000+ capital investment. First the pre-mastering process would take place, where text can be written and configured for display. Mastering for DCC involves merging text with music which would be displayed on the screen of a DCC player (perfect for Karaoke). The success of DCC would be favorable for the established mastering houses.

One certainty is that the technology boom marches on through the 90's. In audio processing this can be summed up as 'the great data compression race' not unlike the computer and telecommunications industries. Recently, Sony Corporation and Sonic Solutions , Inc. have introduced their respective versions of *24 Bit Mapping,* which allows for the input of up to 24-bit data and the output of 16-bit data. The end goal is the reproduction of high-quality sound. This technology will surely be embraced at Masterdisk.

Hard-disk storage systems will also become more prevalent in the 90s, as well as magneto optical (MO). Sony has introduced the PCM 9000 Digital Master Disc Recorder that uses MO discs as its recording medium. MO discs are re-recordable, highly reliable (not susceptible to dropouts) have a long shelf life and are excellent for archiving 20 or 24 bit data. The price tag on the PCM 9000 is $44,000. Remaining state-of-the-art will never be inexpensive.

There will always be a niche for the devoted multi-room mastering house. A place where *full service, experience, and professionalism abound.*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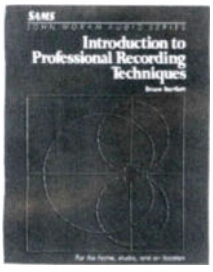

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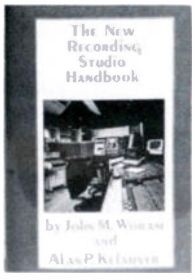

This new edition has been accepted as the long-awaited replacement to the original book published in 1976. The new edition is not "old wine in a new bottle." The revision has been done by Professor Kefauver. He is the Coordinator of the Recording Arts and Sciences Department and Director of Recording at the prestigious Peabody Conservatory of Music. The book is used by most of the recording schools and universities here and abroad. This book contains all the basics for the recording studio engineer, as well as more advanced information covering MIDI, Automated Consoles, SMPTE Time Code and Digital Audio. This book has been and remains the "bible" of the audio industry.

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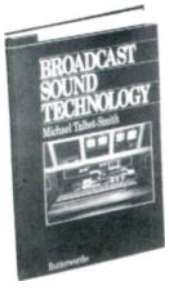

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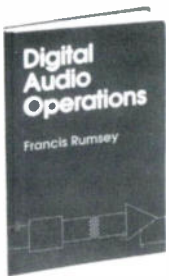

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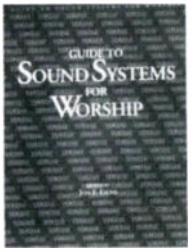

This book is written to assist in the design, purchase, and operation of a sound system. It provides the basic information on sound systems that is most needed by ministers, members of Boards of Trustees and worship and music committees, interested members of congregations, and even employees of musical instrument dealers that sell sound systems. To be of greatest value to all, it is written to be both nondenominational and "non-brand-name."

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SHELLEY HERMAN

Just A Mic And A Mac

Stevan Pasero is a San Francisco native who has made good. He tours the world performing classical and Flamenco concerts. He is a classical guitarist and as such has also toured the world.

HE HAS TRANSCRIBED TO GUItar, sometimes for the first time, such pieces as Tchaikovsky's *The Nutcracker* and *Swan Lake,* Ravel's *Bolero*, Handel's *The Messiah*, Beethoven's *Symphony No 5*, Prokofiev's *Peter And The Wolf,* and Bizet's *Carmen*.

His schooling is in this discipline and in order to do these transcriptions, he must listen to the whole score and reduce the instrumentation to what can be played on a guitar. Quite an undertaking! I've listened to his recordings and they are awesome.

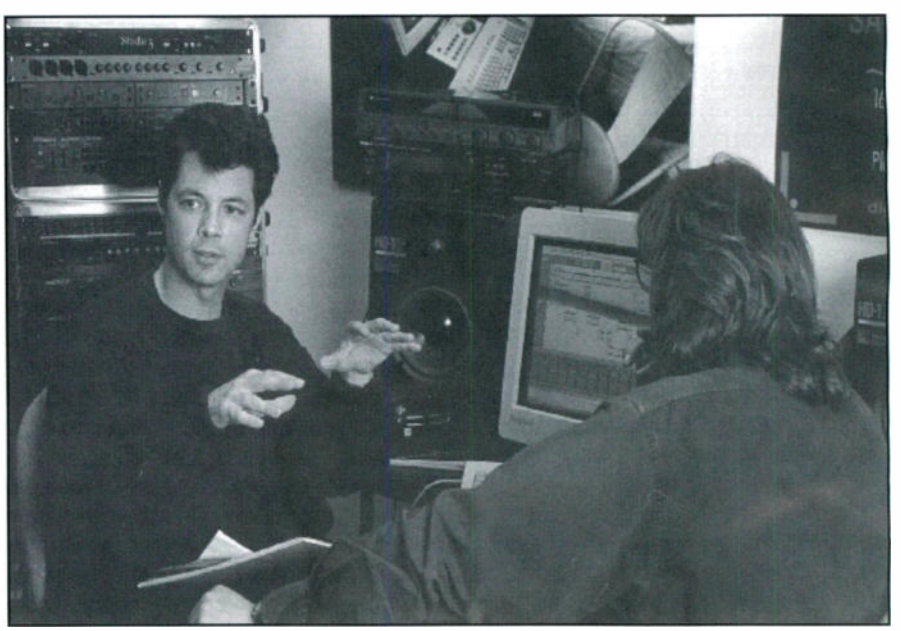
The recordings have an excellent guitar sound and his method of recording is not unique, but evolved over the course of several recordings. Stevan plays in the classical position with the guitar flat on his lap The later recordings were made with the microphones in front of (above) the guitar, one about 3-in. from 12th fret and the other about 2 ½-in. behind the bridge and about 3-in. from the sound board. It took many sessions to develop this method, but it was the one that gave him the sound he wanted. The microphones were AKG 460s. I would love to hear an experiment with the new AKG C 426 B Stereo microphone. I recently acquired one and am awed by its capabilities.

HIS FIRST RECORDINGS

The first recordings, all on Sugo Records, *Nutcracker Suite For Guitar* (1985), *Christmas Classics For Guitar* (1986), and *Guitar Heartongs* (1987) were recorded at the Music Annex in Menlo Park, CA. The two guitar were recorded on two tracks of a 24 track Studer at 30 in.sec., via a Neve 8036 console.

Additional voices, rhythm or enhancement, as needed, were on other tracks of the 24 track. The multi-track was mixed onto a 30 in/sec. quarter inch two track tape recorder. *Guitar Masterpieces* (1988), *Classic Bouquet* (1989), and *Pasero Pasero* (1990), were recorded on the same equipment ex-

Figure 1. Steven Pasero (left) and Christofer Bock, co-producer of ***Seasons.***



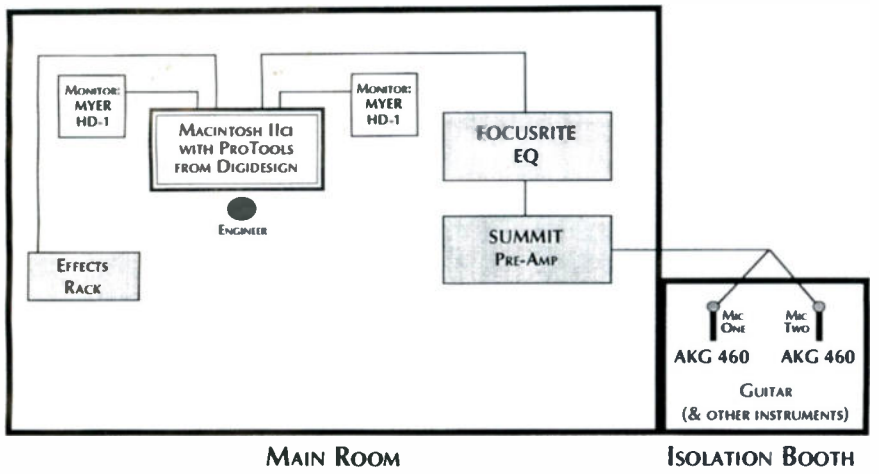


Figure 2. The floor plan for the ***Seasons*** *recording sessions.*

cept that Dolby SR was added to the multi-track and the mixdown was to DAT. The mixdown was then transferred to 1630 for CD production.

His first six records were classical, but *Seasons* is Adult Alternative, more of an easy listening, eclectic music. Not only did *Seasons* win the National Assn. of Independent Record Distributors second-place award for classical recordings, but it got a *Pac Attack* award in *Mac Report* magazine. Talk about the best of both worlds. When recording *Seasons* (1992) the same AKG 460 microphones were used, but there the similarity ended. From there on it was a mic and a mac.!

Summit preamplifiers were used, but thats where the analog stopped! The recorders (and mixing board and equalizers and reverb and everything else) were a Macintosh II FX and II C running Pro Tools, 8 to 16 tracks (as needed), Sound Designer equalization (by Digidesign), mixed to a Sony 2500 DAT, and then mastered to 1630. The recording was done in three home studios, Stevan's, his engineer Russell Bond's, and Christopher Bock's, of Digidesign, a long time associate of Pasero. Some of the percussion and pan flute were sampled and mixed with live players for the special musical effects. He carried his own Meyer HD-1 loudspeakers with just as much care as he carried his guitar.

The next project *Songs For The Wild* will use the same recording architecture as *Seasons* except that it will use CD-20 for 20 bit digital recording. Here is an artist using every means at his disposal to make a better recording, and those in the data compression business are telling us we really don't need all of those bits. Am I missing something?

Using exotic woods and special bracing, Devoe was able to construct an instrument with high volume, clarity, and with extreme transparency when strummed, but when played solo, sounded deep and warm

When listening to the recording of *Seasons*, I was astounded by the sound of the guitar. When I asked Steven about this he explained that on his first recordings he played a Fred Clarke concert classic, but he retired it when he bought the instrument described below.

THE RECORDING OF *SEASONS*

To record *Seasons* Stevan played a classical/Flamenco guitar, handmade by Lester Devoe, who resides in Maine. Making this new instrument was an experiment, as most guitars are either classical or Flamenco. Stevan wanted an instrument that when he played full-bodied chords or melody he would get a masculine sound, for those of us unschooled in the intricacies of guitardom, this translates to sustain, warmth , and volume. He also wanted some feminine characteristics, meaning brighter sound and transparency when clustering several notes together.

A SPECIAL GUITAR

He wanted an instrument that has enough clarity in the middle range so when he plays Rasgeado (the tearing Flamenco technique) the sound isn't muddy. Using exotic woods and special bracing, Devoe was able to construct an instrument with high volume, clarity, and with extreme transparency when strummed, but when played solo, sounded deep and warm. When making these guitars, only one out of ten would come out right, so it's very much an art.

When Stevan compared the new guitar to his Flamenco and classic guitars, he found that, even though his new guitar is a cutaway and has a tap plate, modifications which usually reduce the sound by about 20 percent, the sound characteristics of the new instrument are actually right between the two, but louder than either of the others. It didn't come cheap, but it was worth every penny.

Although *Seasons* is a limited distribution recording when compared to the latest Michael Jackson blockbuster, it is a precursor of things to come. As one who started out with just a Mic And A Wire (recorder)

I am amazed at what can be done with just a Mic And A Mac! db

Historical Perspective

WARREN SIMMONS

Analog Mastering Tape vs Digital Mastering Tape

The following is a detailed comparison of analog and digital tape which we originally published in January 1983. Note what has changed in the last ten years and what has not!

MAGNETIC TAPES for digital mastering present unique design requirements that are quite different from those intrinsic to the formulation of tapes for analog mastering. Therefore, an important part of any discussion about analog and digital mastering tapes should include an analysis of the ways in which the two designs differ. Only then can a serious comparison be made; only then can progress be defined and, ultimately, future developments predicted.

First, let's examine each of the basic elements of *all* magnetic tapes and consider these elements as building blocks, which in themselves may be modified in a myriad of ways. The magnetic tape architect can then select the proper combination of building blocks, fitting them together in specific arrangements to achieve the appropriate tape design goals.

COMMON MAGNETIC TAPE ELEMENTS

Base Film. The foundation of all magnetic tape is the base film. Today's design requirements dictate that a polyester film be used, since polyester's unique properties make it ideally suited for all types of magnetic tape.

Polyester film possesses high-tensile strength, low elongation at working loads and excellent dimensional stability through a wide range of temperature and humidity. It can be cast efficiently in thicknesses as thin as 0.20 mil (0.00020 inch) and as thick as 5.0 mil (0.00500 inch). Its tensile properties may be varied, producing films of high-tensile strength in the longitudinal direction or balanced ones where longitudinal and transverse tensile strengths are similar. Surface smoothness also may be varied to fit specific needs.

Polyester is a generic term, chemically known as polyethylene terphthlate. Familiar trade names are Mylar, manufactured by DuPont; Celanar, from American Hoechst; Hostophan, from Kalle, and Melinex, from ICI.

The Magnetic Particle. The magnetic particle of a tape is the element which undergoes the widest design modification to suit the unique criteria of different tape formulations. In its most widely used form, the magnetic particle is an oxide of iron, needle-like in its physical form and some 10 to 25 microinches in length and 3 to 5 microinches in diameter. Chemically, it is known as gamma ferric oxide (Fe_2O_3), or just plain "iron oxide."

Iron oxide is a crystalline material, the construction of which can be modified by the chemical addition of other materials. In magnetic particle chemistry, the other material most often used is cobalt. By modifying the crystalline structure with the addition of cobalt, the magnetic properties of iron oxide can be changed dramatically.

For example, the most important characteristics of a magnetic particle are coercivity—measured in oersteds—and retentivity—measured in gauss. Gamma ferric or iron oxide particles have coercivity levels of 260 to 380 oersteds, and retentivity levels of 900 to 1500 gauss. Cobalt modification of those particles can produce coercivity levels varying from 350 to 2000 oersteds, and retentivity levels of 1500 to 2500 gauss.

Other magnetic particles are also available to the tape architect. Chromium dioxide is one such particle, with coercivity in the 400 to 600 oersted range, and retentivity ranging from 800 to 2000 gauss. Also, the most recent and glamorous addition to the magnetic-particle building blocks is that of pure iron or metallic particle, with coercivity levels varying from 800 to 2000 oersteds, and retentivity levels as high as 3600 gauss.

It is the tape architect's responsibility to select the proper particle to achieve his design goal, whether it be standard-bias cassette tape, high-bias cassette tape, metal-particle cassette tape, analog mastering, digital mastering, video, instrumentation or computer tape applications.

Warren Simmons was the Poduct Manager, Audio Magnetic Tape Division at Ampex at the time of this article.

Backcoating. In all current magnetic tape technology, a conductive backcoating has become standard design practice, and electrical conductivity is a major concern. By maintaining a minimum conductivity level through the use of carbonous materials, electrostatic generation can be minimized. Magnetic surface conductivity levels can be shifted to backcoat conductivity, thereby maximizing magnetic surface performance while still retaining overall adequate tape conductivity levels. A minimum conductivity level is essential to minimize electrostatic buildup, which, in turn, reduces pickup of contaminating particles and provides cleaner running tape.

Yet another consideration in the design of backcoatings is that of surface roughness. In this case, design tradeoffs are important. As backcoat roughness is increased, high-speed winding uniformity is enhanced. However, the tradeoff penalty is an increase in modulation noise, a most important consideration in all high-quality mastering tape designs.

Once again, the building blocks available to the tape architect in the category of backcoatings are many, and the proper selection is vital to the ultimate performance level of a given tape.

Binder Systems. In magnetic tape design, the selection of the proper binder system is also essential to tape performance. Consider audio mastering applications where two-inch tapes might be required to perform reliably for more than 2000 passes during mixdown, re-mix or overdub sessions at 15 or 30 ips. Compare these requirements with instrumentation tapes that must operate at 120 ips in airborne applications or surveillance logging tapes and medical body-function monitoring applications which must perform at speeds less than 0.2 inches per second. Durability and frictional properties have become prime considerations, and binder systems which include surface lubricating characteristics must also change—yet another set of building blocks from which to choose.

Tape Accumulation/Reels. In the majority of current recording devices, magnetic tape is presented to the recorder by winding on reels. The reel design and physical tolerances of the reel have become critical to the overall recorder performance. Increasing accuracy of all reel dimensions has been recognized as desirable to meet the higher performance requirements of current analog recording, not to mention the requirements of digital recording, where narrower track widths make more precise tape guiding essential.

MAGNETIC TAPE MANUFACTURING CONSIDERATIONS

Magnetic Particle Dispersion: By selecting different manufacturing processes, the uniformity of dispersion or positioning of the magnetic particle throughout the surface of the magnetic tape can be modified. Both electrical noise and dropout activity can be affected by such dispersion. Agglomerates, or particle groupings, can cause increases in noise levels in analog recordings, while particle voids can cause dropouts or bit errors in digital (PCM) recording.

Calendering: After a magnetic tape is coated and dried, it undergoes an operation called calendering, or surface smoothing. The calendering operation performs two basic functions: 1) It compacts the magnetic coating, resulting in an increase in magnetic activity, and 2) it imparts a design surface smoothness and gloss dependent on the selection of calendering media and calendering pressures and temperatures. Higher gloss levels, in general, provide more intimate tape-to-head contact and can improve short wavelength (high frequency) response in analog recording as well as reduce bit error rate in digital recording.

Slitting: In the initial manufacturing stages, magnetic tape processing is carried out in a "web" form with widths of 26 inches or more. After coating, drying and calendering operations, the wide webs of coated material are moved to the slitting operation where they are cut or slit into the appropriate tape widths ranging from 0.150 inch for audio cassette tape applications up to two inches for audio mastering, quadruplex video and rotary instrumentation applications.

Demands for tape-width uniformity are intense. Current applications require tolerances of 0.002 inch or less, and future requirements are already searching for manufacturing methods that can perform reliably within width tolerances no greater than 0.0004 inch to accommodate digital audio track widths of as little as 0.006 inch.

COMPARING ANALOG AND DIGITAL TAPES

Now, after defining the basic elements of all magnetic tapes, we can identify systematically, element by element, the differences between the design requirements for both analog mastering and digital (PCM) mastering tapes. FIGURE 1 is a comparison of analog and digital tape characteristics, and these characteristics are discussed in detail below.

Base Film

Analog Requirements: A thick base is important to minimize print-through. Base film thicknesses from 1.15 mil (0.00115 inch) to 1.45 mil (0.00145 inch) are in general use for high-quality analog mastering. Recorder geometry allows up to 14-inch reels holding 5000 feet, while play speeds not exceeding 30 ips permit 33 minutes of play time.

Digital Requirement: Due to higher track densities resulting in narrower track widths (37 tracks on one-inch tape in the Mitsubishi X-800 recorder), intimate tape-to-head contact is essential, and greater tape flexibility helps meet this need. Since print-through is no longer a consideration, lower film thicknesses from 0.83 to 0.88 mil can be used. In some hardware geometry, linear speeds are higher (45 ips for the 3M systems), and thinner tapes will permit reasonable play time at these higher speeds (32 minutes, using 7200 feet on a 12½-inch reel).

The Magnetic Particle

Analog Requirements: In analog mastering, magnetic particles are always gamma ferric oxide. Because of recorder bias current characteristics, particles must fall into the range of 290 to 380 oersteds. Particles must be selected for bias noise characteristics, print-through, distortion and saturation characteristics.

Digital Requirements: In digital recording, the new term "packing density" becomes an important consideration. Packing density can be considered the number of bits of information which must be handled in any given area of tape. Packing densities are usually described as the number of kilobits per inch of tape. In analog recording at 15 ips, looking at a 20 kHz signal, packing densities would be 1.33 kilobits per inch. If we look at a typical professional digital recorder, operating at a 48 kHz sampling rate and a 16-bit format, the packing density at 30 ips jumps to 25.6 kilobits per inch.

Obviously, substantially higher recording density now is in effect, and in order to accommodate these higher recording densities, magnetic energy levels must also increase. The higher energy levels can be realized by increasing the coercivity level of the magnetic particle. As previously discussed, through the use of cobalt, iron oxide particles can be modified to achieve coercivity levels anywhere between 350 and 2000 oeresteds. Current tapes for digital audio applications are being designed with magnetic particle coercivity in the 600 to 700 oersted range.

COMPARISON CHART: ANALOG VS DIGITAL MASTERING TAPES

Characteristic	Analog	Digital
Base Film		
Composition	Polyester	Polyester
Thickness (mils)	1.15 to 1.45	0.80 to 0.88
Magnetic Particle		
Composition	Gamma Ferric Oxide	Cobalt-Modified Gamma Ferric
Coercivity (Oersteds)	290-380	600-750
Retentivity (Gauss)	1050-1450	950-1250
Back Coating		
Resistivity (Ohms/square)	1×10^4 to 6×10^4	1×10^4 to 6×10^4
Smoothness (μ in peak to valley	20	20
Binder Systems		
Durability	Highest Level	High Level
Shed	Low Level	Lowest Level
Magnetic Particle Dispersion	Highest Level	High Level
Calendering		
Gloss Level (units of reflectance)	90-110	110-120
Slitting		
Width (maximum allowable variation—inches)	0.002	Less than 0.002

Figure 1. A comparison of analog and digital tape characteristics.

Backcoating

Analog vs. Digital Requirements: In both analog and digital tape, the smoothness of the backcoating is an important factor. In the case of analog recording, modulation noise is deteriorated by surface roughness; in digital recording, the same surface roughness can increase error rate levels. In addition, conductivity to minimize airborne dirt becomes extremely important in digital recording in order to minimize error rate levels.

Binder Systems

Analog Requirements: Binder systems for analog tapes must demonstrate extremely high levels of durability to withstand multiple mixdown passes, re-mix activity and overdubs. Surface gloss levels, which promote intimate tape-to-head contact, are not extreme for analog requirements.

Digital Requirements: Because of higher packing densities and narrower track widths, it is necessary that tape for digital use be manufactured to higher gloss levels to accommodate more intimate tape-to-head contact. Modifications in binder systems are required in order to enhance the achievement of these higher gloss levels.

Magnetic Particle Dispersion

Analog vs. Digital Requirements: In both tapes, a high level of dispersion is required, but for different reasons. In analog recording, poor dispersion causes bias noise buildup and an increase in modulation noise. In digital recording, poor dispersion can cause loss of digital information and an increase in error rates.

Calendering

Analog vs. Digital Requirements: Because of higher packing densities, digital recording requires greater tape-to-head contact, which can be achieved through higher gloss levels. By modifying temperatures, pressures and calendering media, gloss levels can be increased to provide a higher level of tape-to-head contact.

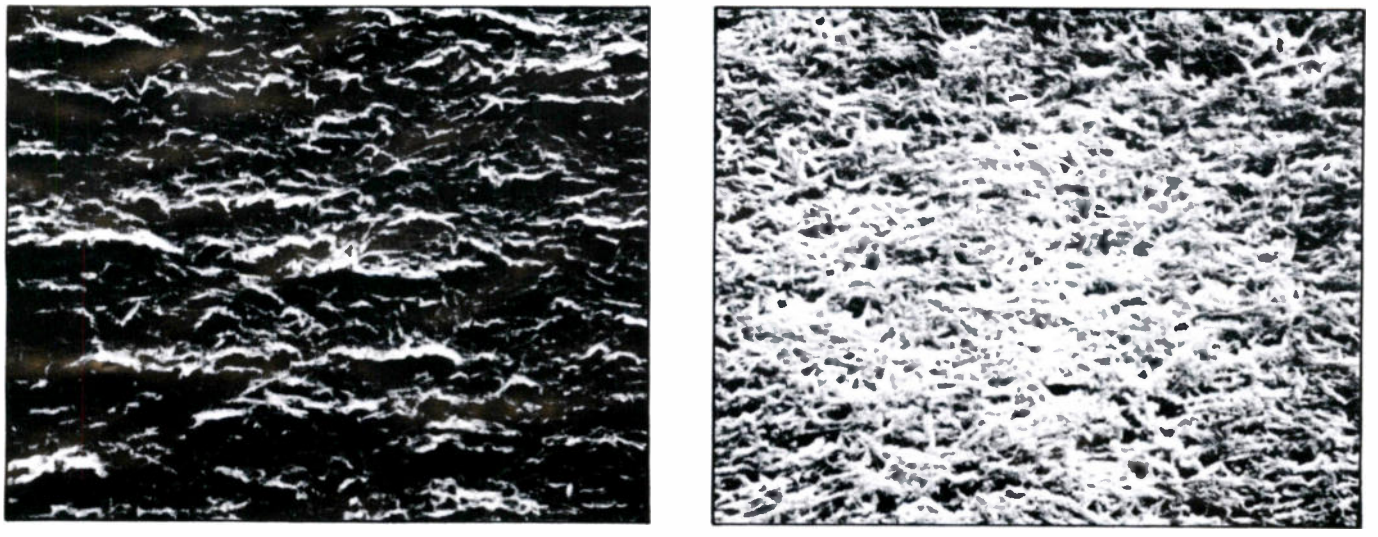


Figure 2. These electron scanning microscope photographs, processed at a diameter magnification of 10,000 and a viewing angle of 45 degrees to the surface, show differences between the Ampex 456 analog (left) and the Ampex 466 high-energy digital tapes. At this magnification, the surface roughness is directly related to the gloss level under standard viewing—the lower the surface porosity, the higher the gloss, as seen in the 466 photograph on the right.

Slitting

Analog vs. Digital Requirements: In general, narrower track widths (currently standard recorder design practice) require lower levels of slitting error. In analog recording, tolerances of 2.0 mils (0.002 inch) have allowed totally acceptable performance, even up to 24-track, two-inch widths. In digital recording, where track widths of 6 mils (0.006 inch) are not uncommon, more precise slitting has been recognized as highly desirable, and tolerances of 0.4 mil are being sought after as standard slitting practice. In addition, tape edge weave—or skew—takes on new importance in digital recording because of the narrow track widths in multi-track recording.

PROGRESS IN MAGNETIC TAPE DEVELOPMENT

The earliest magnetic tapes in the late 1940s were produced on acetate-backed material having relatively low strength and a high degree of sensitivity to dimensional change through temperature and humidity changes. As multi-track recording came into being, a much greater degree of dimensional stability was required as tape widths increased from ¼ inch, to ½, one and finally two inches.

The DuPont Corporation made polyester base film available in the mid-1950s, providing a new, high level of strength and dimensional stability and also making multi-track recording practical from a tape point of view.

Continued development in base film technology has increased the overall accuracy of manufacturing in magnetic tape with improved slitting tolerances and better tape surfaces. Oxide development has taken tape from a coercivity level of 240 oersteds (with retentivity levels less than 800 gauss with signal-to-noise ratios possible of only about 50.0 dB) up to coercivity levels of 380 oersteds, retentivity levels of 1500 gauss, and with a great improvement in particle size, allowing a significant reduction in noise levels. Magnetic particle chemical modification through the use of cobalt has provided an even wider selection of particle energy levels for meeting the needs of applications such as digital recording. The advances in binder system chemistry have provided increases in durability as have been described in analog mastering for multiple mixdown passes. Surfaces today are tougher and more durable than in the original magnetic tapes. Backcoating of magnetic tape to improve winding properties, tape pack information and cleanliness of running is a relatively recent design improvement and has allowed tape performance to improve, particularly from a dropout and overall cleanliness point of view.

THE APPEARANCE OF DIGITAL AUDIO TAPE

The first digital audio tape presented to the marketplace was Ampex Corporation's 460 Series, formally introduced at the AES Show in New York in 1977. Hardware requirements at that time were operating at relatively low packing densities and wide track widths. The Ampex 460 Series was a 300 oersted tape which performed satisfactorily on the first generation of digital audio recorders.

When multi-track recorders (the 3M one-inch 32-track, the Mitubishi one-inch 32-track and the more recent Sony ½-inch

Digital Audio Recording Tape Specifications

MANUFACTURER	AMPEX		3M	
Tape Type	**460**	**466**	**265**	
Physical Properties				
Base film thickness	1.00	0.88	0.79	(mils)
Oxide thickness	0.20	0.20	0.16	(mils)
Backcoat thickness	0.04	0.04	0.10	(mils)
Total thickness	1.26	1.12	1.05	(mils)
Width ¼"	n/a	247	n/a	(mils)
Width ½"	498	498	498	(mils, nominal)
Width 1"	997	997	998	(mils, nominal)
Yield strength	n/a	n/a	13	(lbs. per inch)
Breaking strength	n/a	n/a	21	(lbs. per inch)
Magnetic Properties				
Retentivity	1000	1300	1350	(gauss)
Coercivity	310	650	720	(oersteds)
Erasure field	1000	n/a	n/a	(oersteds, for 60 dB erasure)
Performance Specifications				
Sensitivity	0, +/-1	n/a	n/a	(dB)
Wavelength response	0, +/-1	n/a	n/a	(dB, 1-0.10 mil)
	0, +/-1.5	n/a	n/a	(dB, @ 0.08 mil)
	0, +/-2.0	n/a	n/a	(dB, @ 0.06 mil)
1.5 MHz Slot S/N	>46	n/a	n/a	(dB)
Uniformity	2.0	n/a	n/a	(dB max, 1 MHz signal)
Environment				
Operating	40-120	n/a	55-85	(degrees, F.)
	25-95	n/a	25-75	(%, rel. hum.)
Storage	10-120	n/a	50-90	(degrees, F.)
	10-95	n/a	25-75	(%, rel. hum.)

n/a = Information not provided on Specification Sheet.

24-track) made their appearance, low coercivity levels were no longer acceptable. Gloss levels likewise were too low for intimate tape-to-head contact and acceptable dropout activity.

At the AES Show in Los Angeles in May of 1981, the Ampex 466 Series of digital audio tape was introduced. Design criteria for digital audio tape now had shifted, and a different set of building blocks was selected. Magnetic particle coercivity was increased to 650 oersteds, and a cobalt-modified gamma ferric oxide was used. The binder system was also modified, allowing for a higher degree of calendering and for higher gloss levels for better tape-to-head contact. With higher packing densities, dropout activity became a far more important consideration.

MAGNETIC TAPE: ITS FUTURE AND ITS VARIOUS APPLICATIONS

Most experts agree that analog mastering will continue to flourish. Because of an extremely large installed population of analog recorders, efforts will continue to improve the overall quality of analog recording. The current move from ¼-inch mixdown to ½-inch mixdown, providing about a 5.0 dB improvement in signal-to-noise, is one such example of application improvement.

Tape manufacturers also will continue their efforts to locate oxides having lower noise, higher output, lower distortion and lower print-through.

The move to multi-track digital mastering will place extremely stringent requirements on tape manufacturers. Tape surfaces will become ever more important as packing densities increase, and tape manufacturers will have to improve the overall cleanliness of the recording surface to meet both the high packing-density requirements in digital audio and the desire for lower dropout levels in all video applications.

As cassette recording in the Philips audio format moves into digital configurations, even higher particle energy levels will be required to accommodate the high-packing densities of this narrow-track application. One of the current experimental Philips digital audio configurations requires a coercivity level of approximately 1250 oersteds—higher than any other current recording application.

Miniaturization of recording devices such as the micro-cassette for high-fidelity audio applications and digital audio cassette recording systems, plus continued movements toward higher packing densities as a result of lower linear tape speeds, will accelerate development efforts in all areas of magnetic tape.

To keep up with such developments, industry research activities, like those of Ampex Corporation's Magnetic Tape Division Laboratory, will carry on their work, dedicated to supplying the ever-changing recording industry with high-performance tapes that can meet these challenging needs. ■

(continued on page 48)

Introduction to the Charts

We've tried to make the charts of amplifiers as self-explanatory as possible, with slanting headlines on each column that explain what we wanted to show you.

These charts represent entirely what each of the respective manufacturers have sent us in response to our (sometime repeated) requests. You will also see that there are numbers of blank sections within the charts. If they don't have a specification available, we can't list it. But note that many do not have anything under the Features column. This column is where we have invited each manufacturer to state, in as few words as possible, what is special about the product. You can safely assume, then, that when this column is blank, it is because the manufacturers told us nothing.

Note also that we ask for amplifier continuous power not only at the traditional 8 and 4 ohm resistive loads, but also at 2 ohms. As you know, when you parallel speakers, the load is halved. Accordingly, in the real worlds of studio monitors and headphone lines, and the even more real world of performance and stadium systems, effective loads back to an amplifier can well be 2 or 3 ohms. Since modern solid-state amplifiers can handle such loads successfully, we ask each manufacturer for this specification. Note that not all give it. It's, therefore, safe to assume that if it is missing, the amplifier may not be reliable at low loads.

Distortion at normal and full power ratings is also specified. While many amplifiers today can boast of almost vanishing distortion, remember that if you will be pushing an amplifier hard up against its rated power and beyond, distortion will then be rising rapidly. No audio product is really made to be abused, and amplifiers are no exception.

One group of important specifications deals with dimensions and weights. Amplifiers, particularly high-power ones, are not lightweights. A few racks can have weights adding up rapidly.

Finally, the price. What we have asked each manufacturer for is the suggested retail price. Different retail dealers establish their own.

On to the charts...

Model	Number of Channels	Cont.power/channel at 8 ohms, all channels driven	Cont.power/channel at 4 ohms, all channels driven	Cont.power/channel at 2 ohms, all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/– dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
AB INTERNATIONAL ELECT. INC.															
1200	2	800	1350	1950	20-20k	0.05	0.05	0.25	0.25	20-20k +–0.25	1.9	5.25	68 19 15	$2,699.00	Fully modular, soft clipping, led display
1100	2	525	850	1100	20-20k	0.05	0.05	.025	0.25	20-20k +–0.25	1.5	5.25	39 19 13	$1,249.00	Signal/clip indicators, led display option
900	2	350	590	775	20-20k	0.05	0.05	0.25	0.25	20-20k +–0.25	1.5	5.25	34 19 13	$1,039.00	As 1100 model above
600	2	270	425		20-20k	0,05	0.05	0.1	0.1	20-20k +0.25	1.5	5.25	33 19 12	$829.00	Signal/clip indicators
ALESIS CORPORATION															
RA100	2	75	100		20-20k			.05	0.19	20-20k 1	0.5	3.5	15 19 8.5	$349.00	UL and UA listed requires no fan, Short circuit protected.
ALTEC LANSING CORPORATION															
9441A	2	75	100		20-20k	0.1	0.1	0.1	0.1	10-50k +0,—3	0.75	1.75	1.75 19 12.8	$682.00	Balanced inputs, poweredaccesory sockets, front-panel controls, 200W Bridged into 8-ohms.
9444B	2	200	300		20-20k	0.05	0.05	0.1	0.1	10-90k 0,-3	0.78	34	5.25 19 12.75	$990.00	Balanced XLR/barrier strip inputs, level controls on back panel, 300W bridged into 8 ohms.
9442A	2	100	150		10-50k	0.1	0.1	0.1	0.1	10-50k +0,-3	.775	532	5.25 19 11	$764.00	Balanced inputs, powered accesory sockets, back-panel controls, 200W brisdged into 8-ohms.
9446A	2	400	600		20-20k	0.05	0.05	0.01	0.1	10-90k +0,-3	.78	5.25	52 19	$1,886.00	Balanced inputs,1200W bridged into 8-ohms, level controls on back panel,
APIX SYSTEMS See outr ad on page 2															
SS1200	2	425	625		20-20k			0.02	0.04	20-20k +–0.4	0.775 or 1.6	33		$1,342.00	Balanced inputs, 2 fans,phase reverse, switchable bridge, all mosfet.
SS600	2	250	350		20-20k			0.02	0.04	20-20k +–0.4	0.775 or 1.6	26		$999.00	As above.
SS300	2	100	150		20-20k			0.02	0.04	20-20k +–0.4	0.0775	15		$679.00	Jack input, XLR output, fan cooled.
BGW SYSTEMS															
GTA	2	360	625	1000	20-20k	less than 0.05	0.03	less than 0.1	less than 0.1	3-85k +0,-3	1.73	5.25	78 17.5 16.3	$2,199.00	Twin power supplies, balanced inputs w/looping XLRs and 1/4 in. TRS.
GTB	2	300	450	425	20-20k	less than 0.05	0.03	less than 0.1	less than 0.1	3-85k +0,-3	1.54	5.25	50 19 14.3	$1,539.00	Balanced inputs w/looping XLRs and 1/4 in. TRS, fan cooled, large LED status indicators.
GTC	2	325	550		20-20k	less than 0.1	less than 0.01	less than 0.1	less than 0.1	1-85k +0,-3	1..61	45	3.5 19 17.5	$2,099.00	Active Blanced inputs, subsonic filters forced air cooling, 5-way binding posts, Neutrik Speakon connectors.
750F/G	2	300	450	425	20-20k	less than 0.05	0.01	less than 0.1	less than 0.1	3-85k +0,-3	1.5	7	55 19 15	$1,699.00(F) $1,849.00(G)	LED status indicators, thermostat fan control, 850 w/2 ohm single channel, (G) stereo 50 dB range metering.
6500T	2	100	150		20-20k	less than 0.1	less than 0.05	less than 0.05	less than 0.05	3-100k +0,-3	0.9	3.5	28 19 12.9	$599.00	Barrier strip inputs/outputs w/ 1/4 in. TRS, optional XLR balanced inputs, rearmounted level controls
7500T	2	200	300		20-20k	less than 0.1	less than 0.05	less than 0.1	less than 0.1	3-85k +0,-3	1.18	5.25	36 19 12.4	$849.00	Barrier strip inputs/outputs w/ 1/4 in. TRS, optional XLR balanced input, rear mounted level controls.
Performance Series1	2	200	300		20-20k	less than 0.1	less than 0.05	less than 0.1	less than 0.1	3-85k +0,-3	1.61	30	3.5 19 13.5	$799.00	Active balanced inputs, forced air cooling, LED indicators, XLR and ¼-in outputs.
Performance Series 2	2	100	200		2—20k	less than 0.1	less than 0.05	less than 0.1	less than 0.1	3-85k +0,-3	0.76	32	3.5 19 13.5	$929.00	As Series 1 above.

Model	Number of Channels	Cont.power/channel at 8 ohms, all channels driven	Cont.power/channel at 4 ohms, all channels driven	Cont.power/channel at 2 ohms, all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/– dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
BIAMP SYSTEMS (ADVANTAGE DIVISION)															
Advantage CPA-130	2	40	65			0.05	0.08	0.5	20-20k +0,-0.5	1	3.5 19 10	22			Stereo/mono bridge, front or rear controls peak indicators,passive cooling.
Advantage CPA-650	2	200	325			0.3	0.08	1	20-20k +0,-0.5	1	5.25 19 11	33			650W-bridged mono,front/rear controls, peak indicators,passively cooled.
								0.08							•
Advantage D-60	1	60	60			0.05			20-20k +0,-0.5	1	3.5 10.2 11.4	15			Available as D60EQ with a 9-band eqalizer; Available as D60M with 9-band eq and 2-chan mixer.
BRYSTON/BRYSTON VERMONT															
2BLP	2	50	100		1-100k	less than 0.01	less than 0.01	less than 0.01	0.01	1-100k	0.75	1.75 19 10	18	$775.00	Full twenty year warranty on .all units
3B	2	100	200		1-100k	less than 0.01	less than 0.01	less than 0.01	0.01 20-20k	1-100k	1.0	2.25 19 9	30	$1,3.75.00	Modular construction.
4B	2	250	400		1-100k	less than .01	0.01	less than .01	0.01 20-20k	1-100k	1.25	2.25 19 13.5	45	$2,095.00	All triple good plater contacts.
7B	1	500	800		1-100k	less than 0.01	0.01	less than .01	0.01 20-20k	1-100k	1.0	2.25 19 13.5	45	$2,195.00	All discrete.
CARVER CORPORATION															
P1200	2	450	600		5-80k		0.1		0.5	20-20k +0,-.5	1.5	3.5 19 12.75	21	$1,250.00	Bridged mono operation—70V direct drive operation, remote/sequential power on—LED power meters—XLR.
PT1250	2	465	625		5-80k		0.1		0.5	20-20k +0,-.5	3.5	11 19 10.75		$1,500.00	Has 70V direct drive operation, LED power meters, XLR, TRS inputs clipping eliminator circuit.
PT1800	2	600	900	1100			0.1		0.5	1.5	5.20	46 19 12.75			Bridged mono operation, 70V direct drive, operation-dual detachable power cords, fully modular.
PT2400	2	750	1200	1500			0.1		0.5	5	1.5	5.20 19 12.75	52		Same
M120	2	40	60		2-120k		0.1		0.5	20-20k +0,-.5	1	10 19 12		$560.00	Bridged mono operation, headphone jack—XLR, TRS, barrier strip in-inputs—clip indicators.
M300	2	110	150		4-70k		0.1		0.5	20-20k +0,-.5		11 19 12		$680.00	Bridged mono operation, headphone jack—XLR, TRS, barrier strip in-puts—LED power indicators.
M600	2	200	300		5-80k		0.1		0.5	20-20k +0,-.5		23 19 11.56		$820.00	Remote/sequential power on/off circuit—convection cooling—bridged mono operation XLR.
M900	2	350	450		5-80k		0.1		0.5	20-20k +0,-.5	3.5	24 19 11.56		$995.00	Same, with fan cooling.
CARVIN															
FET 1000(W)	1	300	500		20-20k			.05	.05	20-20k	37		19 10	$679.00	Mosfet circuitry, speaker guard protection, short circuit current limiting thermal shut off switch.
FET 450	2	125	450		20-20k			.05	.05	20-20k			32 19 10		$499.00Same
FET 401(W)		150	300	400	20-20k			less than 0.1	less than 0.1	1	20-20k		19 10	$399.00	Has 9 band graphic equalizer, thermostatic protection.
CREST AUDIO, INC.															
Fcv220	2			110		60-18k	0.015	0.015	0.025	0.025	60-18k +0,-3	0.775	3.5 19 14	42	$880.00	Isolated X-former-coupled (bypassable),fan.
Fcv440	2		220			60-18k	0.015	0.015	0.025	0.025	60-18k +0,-3	0.775	3.5 19 14	50	$1,188.00	Same as above.
ul601	2	120			20-20k	0.015	0.015	0.025	0.025	20-20k	0.775	3.5	33		$768.00	UL listed, fan cooled.

Model	Number of Channels	Cont.power/channel at 8 ohms, all channels driven	Cont.power/channel at 4 ohms, all channels driven	Cont.power/channel at 2 ohms, all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/– dB	Sensitivity for full output, V		Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
											+0,-0.5		19 11.5			
ul901	2	225	300	400	20-20k	0.015	0.025	0.025	0.025	20-20k +0,-0.5	0.775	3.5	40 19 14		$966.00	UL listed, fan colled.
ul1201	2	280	450		20-20k	0.015	0.0.015	0.025	0.025	20-20k +0,-0.5	0.775	3.5	42 19 14		$1,398.00	As directly above.
ul2401	2	330	580		20-20k	0.015	0.015	0.025	0.025	20-20k +0,-0.5	0.775	3.5	61 19 16.5		$1,674.00	As above.
4601	2	300	425		20-20k	0.015	0.015	0.012	0.02	20-20k +0,-0.3	1.03	3.5	52 19 16		$1.750.00	Tailored for mid and high freq. applications.
3301	2	220	330	400	20-20k	0.015	0.015	0.0.25	0.025	20-20k	0.9 +0,-0.3	3.5	49 19 16		$1,390.00	As directly above.
CROWN INTERNATIONAL, INC.																
MA600	2	235	340	410	20-20k	.05	.05	.05	.05	20-20k 0.01	.725	3.5	39 19 16		$1,295.00	P.I.P ,Q compatible, ODEP, IOC, balanced XLR input, front panel level, SPI indicators, air cooling ground isolation switch.
MA1200	2	320	495	200	20-20k	.05	.05	.05	.05	20-20k 0.01	0.775 +-0.1	3.5	44 19 16		$1,595.00	As above
MA2400	2	520	820	1100	20-20k	.05	.05	.05	.05	20-20k 0.01	0.775 +-0.1	3.5	51 19 16		$1,995.00	As above.
MA3600	2	1165	1655	1800	20-20k	0.05	0.05	0.1	0.1	20-20k	0.775 +-0.1	3.5	56 19 16		$2,895.00	As above.
CT200	2	100	155		20-20k	.05	.05	.05	.05	20-20k 0.1	0.775	3.5	21 19 16		$790.00	P.I.P and IQ compatible, grounded bridge , 70-V direct mode,bridged mono, ODEP, IOC,balanced input barrier block connector.
CT400	2	210	230		20-20k	.05	.05	.05	.05	20-20k 0.1	0.775	3.5	31 19 16		$1,050.00	As directly above.
CT800	2	305	410		20-20k	.05	.05	.05	.05	20-20k 0.1	0.775	5.25	46 19 16		$1,550.00	As above
CT1600	2	540	850		20-20k	.05	.05	.05	.05	20-20k 0.1	.775	7	57 19 16		$1,990.00	As above.
ELECTRO-VOICE																
AP2300A	2	100	150		10-50k	less	less than 0.1	less than 0.1	less than 0.1	20-20k than 0.1	.775 1	5.25	32 19 11	$	810.00	Available with precision stepped attenuators. Has rear mounted level controls and octal crossover sockets.
AP2600A	2	200	300		7-85k	less than .03	less than .03	less than .05	less than .01	20-20k 1	.775	5.25	39 19 12.75		$1,040.00	Same
AP3200	2	400	600		10-90k	less than .05	less than .05	less than .02	less than .01	20-20k 1	.775	5	.25 19 15.75	52	$1,890.00	
7300A	2	250	425	500	7-85k	0.03 .03	.03	.05	.01	20-20k 1	.775	5.25	39 19 12.75		$1,040.00	Each amp individually measured and certified for power and distortion.
7600	2	400	600	850	10-90k	less than .05	less than .05	less than .02	less than .10	20-20k 1	.775 1	5.25	52 19 15.75		$1,830.00	Same
HAFLER PROFESSIONAL/DIVISION OF ROCKFORD CORPORATION																
P1200	1 or 2	60	85		10-40k		.005		.01	10-40k -.5	1.1V	3.25	18 19 9.5		$500.00	Has 60 watts per channel, balanced 1/4 in. and XLR inputs, lateral mosfet outputs, level controls.
P2400	1 or 2	120	200		4-40k		.005		.025	4-40k -.5	1.2	5.25	27 19 10.5		$630.00	Has 120 watts per channel, balanced 1/4 in. and XLR inputs, lateral mosfet outputs. I
P5000	1 or 2	325	450		10-40k		.01		.025	10-40k -.5	1.5	3.5	40 19 14		$1,200.00	Yields 325 watts per channel, balanced inputs, lateral mosfet outputs, front panel level controls.

Model	Number of Channels	Cont.power/channel at 8 ohms, all channels driven	Cont.power/channel at 4 ohms, all channels driven	Cont.power/channel at 2 ohms, all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/– dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
JBL PROFESSIONAL															
6290	2	300	600		20-20k	less than 0.1	less than 0.1	less than 0.1	less than 0.1	20-20k +0,-1	1.1	7	63 19 14	$1,735.00	Balanced bridging input circuitry, full complementary driver and output circuitry.
SR6615	2	75	150	250	20-20k	less than 0.1	less than 0.1	less than 0.1	+0,-1 than 0.1	1.1	3.5	32 19 17.5	$680.00	Has 2 rack space unit, variable speed fan, rear to front coling system,.
SR6630	2	150	300	500	20-20k	less than 0.1	less than 0.1	less than 0.1	+0,-1 than 0.1	1.1	3.5	34 19 17.5	$940.00	Has 2 rack space unit, modular power supply and amp channels, balanced XLR and 1/4 in. phone input.
PANASONIC PROFESSIONAL AUDIO SYSTEMS															
WP-9055	2	50			10-85k	less than 0.05	less than 0.05	less than 0.05	20-20k than 0.05	+4	1.75 dBv	19 18.9 13.13	$620.00	U.L. listed and carries five year limited parts and labor warranty.
WP-9110	2	100	150		10-85k	less than 0.05	less than 0.05	less than 0.05	20-20k than 0.05	+4	3.5 dBv	28.6 18.9 15.06	$699.00	Same
WP-9220	2	200	300		10-85k	less than 0.05	less than 0.05	less than 0.05	20-20k than 0.05	+4	5.25 dBv	38.6 18.9 15.06	$899.00	Same
WP-9440	2	350			10-60k	less than 0.06	less than 0.06	less than 0.06	20-20k than 0.06	+4	5.25 dBv	75 18.9 19.13	$1,810.00	Same
PEAVEY ELECTRONICS CORPORATION															
IPA 70 PLUS	2	30			20-20k			0.01	20-20k	0.775 +-1	7	10 5.25 8.25	$99.99	half-rack width, rear-mounted level controls, 1.4 jack inputs.
IPA 250	2	70	125		20-20k			0,01	20-20k +-1	1	5.25	26 19 11.5	$499.99	Distortion Detection Circuitry (DDT).leds indicate DDT, separate channel level controls.
IPA150T	1	150	150		20-20k			0.5	20-20k +1,-2	1	19	26 15.50 4.5	$498.75	Level control, selectible subsonic filter, balanced XLR.
IPA300T	1	300	300	300	40-20k			0.19	40—20k +-1	1	13,4	40 19 5.75	$749.75	As above plus 70V line output.
IPS 400	2	120	200		10-50k			0.05	5-50k +0,-1	1	5.25	40 19 12.4	$874.99	Barrier-strip in/out, bridgeable, level controls.
IPS 800	2	240	400		10-50k			0.05	5-50k +0,-1	1.4	5.25	45 19 14.4	$1,049.99	As above.
QSC AUDIO PRODUCTS INC.															
MX 700	2	150	225	350	5-65k	.01	.025	0.1	0.1	20-20k	1.0 0.25	3.5	25 19 12	$688.00	Has 1/4 in and barrier strip inputs, fan cooled, compact package.
1200	2	100	150	250	5-60k	.01	.025	0.1	0.1	20-20k	1 1	5.25	24 19 9.5	$638.00	Has 1/4 in. XLR, and barrier strip inputs, optional fan cooling, rear gain controls.
1400	2	200	300	450	5-65k	.01	.025	0.1	0.1	20-20k	1 1	5.25	34 19 9.5	$838.00	Has 1/4 in. XLR and barrier strip inputs, fan cooled, rear gain controls.
MX 1500A	2	330	500	750	8-300k	.01	0.02	0.1	0.1	20-20k	1 1	3.5	47 19 17.9 15.9	$1,258.00	Dual mono design, fan cooled, 1/4 in. barrier strip inputs.
EX 4000	2	720	1100	1400	8-100k	.01	0.05	0.1	0.1	20-20k	1.0	5.25	64 19 17.9	$2,398.00	Open input architecture, speaker connectors, advanced thermal mgmt. system..
RANE CORPORATION															
MA6	6	100	150	150	20-20k	0.1	0.1	0.07	0.07	5-50k +0,-3	0.775	5.25 19	44 11	$99.00	Built-in limiter on each channel, level controls, auto bridging.

Model	Number of Channels	Cont.power/channel at 8 ohms, all channels driven	Cont.power/channel at 4 ohms, all channels driven	Cont.power/channel at 2 ohms, all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/– dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
RENKUS-HEINZ, INC.															
P-2500	2	400	600	700	20-20k		0.05		0.025	20-20k +0,-5	1.2	3.5	48.5 19 16	$2,092.50	Chip-Guard protection,servo-controlled variable-speed fan.
P-2000	2	300	500	600	20-20k		0.015		0.025	20-20k +0,-5	1.1	3.5	45.5 19 16	$1,530.00	As above.
SOUNDCRAFTSMEN															
A100	2	60	60		10-100k	0.05	0.05	0.05	0.05	20-20k +–0.1	1.25	1.75	17 17 10.87	$49.95	Gold RCAinputs, semi-torroidal power supply, MOSFET amp.
A200	2	125	190		10-100k	0.05	0.05	0.05	0.05	20-20k +–0.1	1.25	5.25	27 17 10.87	$469.95	As above, linear power supply.
A400	2	205	300	450	10-100k	0.05	0.05	0.05	0.05	20-20k +–0.1	1.25	5.25	30 17 10.87	$759.95	As above, phase control regulated power supply.
PM860	2	210	315	450	20-20k	.05	.05	.008	.05	20-20k			5 20 8.5 14	$599.00	Has high current design to allow stability with 2 ohm loads.
450X2	2	210	315	450	20-20k	.05	.05	.008	.05	20-20k	1.2	5.25	28 19 11.75	$849.00	High current MOSFET amp with balanced or unbalanced inputs.
900X2	2	375	675	900	20-20k	.05	.05	.008	.05	20-20k	1.22	5.25	59 19 16.5	$1,599.00	Same
300X4	2, 3 4	600 205	900 300	450	20-20k	.05	.05	.008	.05	20-20k	1.0	5.25	60 19 14	$1,399.00	Multi-channel MOSFET, 2, 3 or 4 channel mode indicators, front panel-mounted circuit breakers.
SOUNDTECH															
PL150	2	55	75		15-30k			.007			1.23	1.75	17 19 8.5	$419.90	Single rack space, clip, protect, power and bridge/mono LED indicators, protection circuit.
PL250M	1	113	200	300	18-31k			.007			1.23	3.5	30.8 19 16	$449.90	Built-in 9 band graphic EQ, clip, protect, power and temp. LED indicators protection circuitry.
PL500	2	165	250		20-20k			.007			1.23	3.5	39 19 16	$599.90	Clip, protect, power, temp. and bridge/mono LED indicators, protection circuity,
PL1000MP	4	165	210		20-20k			.007			1.23	3.5	59 19 16	$1,099.90	Four channels, clip protect, power temp. and bridge/mono LED indicators. Protection circuitry.
PA50B	2	25	50	50	5-100k		0.04		0.03	20-20k	1	1.7	3.5 8.5 6.2	$279.00	Same, and balanced version also features level controls and clipping indicators.
PA100U	2	50	90	100	5-100k		0.08		0.04	20-20k	1	1.7	5.5 8.5 10.2	$324.00	Switch mode power supply design reduces size and weight. Set up for unbalanced signals.
PA100B	2	50	90	100			0.07		0.04	20-20k	1	1.7	5.5 8.5 10.2	$359.00	Same, and setup for balanced or unbalanced; balanced version features level control and clipping indicators..
PA-1200	2	250	400	600	3-180k		less than 0.1		0.06	20-20k	750 1	3.5	15 19 12.53	$999.00	Fully dual-monaural design utilizing switch mode power supply.
PA-1600	2	350	500	800	15-45k			0.01	0.1	20-20k	0.775	3.5	17 19 16	$1,499.00	
STUDER REVOX AMERICA, INC.															
B242	2	200	300		20-20k		0.01		0.01	20-20k +0,-0.3	1.55	18.4	40 6 14.2	$2,900.00	MOSFET drive and special bipolar power transistors, two power transformers, mono bridgeable.
A68	2	150	250		30-15k +0,-0.5		0.1			30-15k +0,-0.5		19.5	46 5.5 13.5	$995.00	Fully complementary from input to to output, mono bridgeable.

Model	Number of Channels	Cont.power/channel at 8 ohms, all channels driven	Cont.power/channel at 4 ohms, all channels driven	Cont.power/channel at 2 ohms, all channels driven	Power Bandwidth Hz-kHz	IM at 1 watt, %	IM at full power, %	THD at 1 watt, %	THD at full power, %	Frequency Response at 1W +/– dB	Sensitivity for full output, V	Dimensions, H/W/D, in.	Weight, lbs.	Price, $	Features
SUNN															
SPL7450	2	275	450	10-50k	less than 0.05	1	0.03	1	5-50k +0,,-3	+4	5.25	38 19 15		$899.00	Two speed fan, compressor, male and female XLR input connectors and balanced 1/4 in.
2150	1	150	250	10-50k		0.1			5-40k +0,-3	0.625	14	25 19 3.5		$599.99	
SPL6000	2	175	300	10-50k		0.05			5-50k	0.625 +0,-3	3.5	25 19 25		$699.00	
SYMETRIX															
220	2	20	20	20-20k			.02	.03	20-20k	.5	1.75	9 19 12		$349.00	Stereo, 2-channel or mono-bridged operation. Balanced XLR/balanced and unbalanced 1/4 in. inputs.
P-1030D	2	100	150		0.02	0.05	0.03	0.01	20-20k +0,-2	+4dB	5.25	39.8 19 13.75			
P-1060D	2	200	300		0.02	0.05	0.03	0.01	20-20k +0,-2	+4dB	5.25	44.2 19 13.75			
P-1090D	2	300	450		0.02	0.05	0.03	0.01	20-20k +0,-2	+4dB	5.25	48.5 19 13.75			
YAMAHA CORPORATION OF AMERICA															
P2700	2	350	500	10-50k	less than 0.03	less than 0.05		less than	10-50k than 0.05		1.23	5.25 18.88 17.25		$995.00	High-power stereo operation with 500W/channel, or 1,000W in bridged mono operation-forced air cooling.
P2350	2	175	250	10-50k	less than 0.03	less than 0.05		less than	10-50k than 0.05	1	.23	5.25 18.88 11.25		$795.00	XLR and 1/4 in. input jacks, binding post and 1/4 in. output jacks-forced air cooling.
P2075	2	50	75	10-50k		less		less	10-50k than 0.003		1.23	3.878 18.88 14.38		$395.00	XLR and 1/4 in. input jacks, binding post and 1/4 in. output jacks-compact and lightweight.
P2160	2	80	125	10-40k	less than 0.03	less than 0.05		less than	10-50k than 0.05		1.23	3.44 23 18.88 14		$595.00	Same
PC4002M2	4	30	700	10-100k	less than .005	less than 0.01		less than	10-50k than 0.01		1.23	7.95 18.88 18		$2,795.00	High power "audiophile" monitor amp with calibrated meters.

Addresses

AB International Electronics, Inc.
1830-6 Vernon Street
Roseville, CA 95678

Alesis Corporation
3630 Holdrege Avenue
Los Angeles, CA 90016-4304

Altec Lansing Corporation
P.O. Box 26105
Oklahoma City, OK 73126

ARX Systems
P.O. Box 0842
Silverado, CA 92676-0842

BGW Systems
Box 5042
Hawthorne, CA 90251-5042

Biamp Systems(Advantage Division)
14270 NW Science Park Drive
Portland, OR 97229

Bryston/Bryston Vermont
979 Franklin Lane
Maple Glen, PA 19002

Carver Corporation
20121 48th Avenue West
Lynnwood, WA 98046

Carvin
1155 Industrial Avenue
Escondido, CA 92025

Crest Audio, Inc.
150 Florence Avenue
Hawthorne, NJ 07506

Crown International, Inc.
P.O. Box 1000
Elkhart, IN 46515-1000

Electro-Voice
600 Cecil Street
Buchanan, MI 49107

Hafler Professional/Division
of Rockford Corporation
5910 Crescent Boulevard
Pennsauken, NJ 08109

JBL Professional
P.O. Box 2200
8500 Balboa Boulevard
Northridge, CA 91329

Panasonic Pro Audio Systems
6550 Katella Avenue, 17A-7
Cypress, CA 90630

Peavey Electonics Corporation
711 A Street
Meridian, MS 39301

QSC Audio Products Inc.
1926 Placentia Avenue
Costa Mesa, CA 92627

Rane Corporation
10802 47th Avenue West
Mukilteo, WA 98275

Renkus-Heinz, Inc.
17191 Armstrong Avenue
Irvine, CA 92714

SoundCraftsmen
2200 South Ritchey Street
Anaheim, CA 92705

SoundTech
255 Corporate Woods Parkway
Vernon Hills, IL 60061

Studer Revox America, Inc.
1425 Elm Hill Pike
Nashville, TN 37210

SUNN
7975 N. Hayden Rd.
Scottsdale, AZ 85258

Symetrix
4211 24th Avenue West
Seattle, WA 98199

Yamaha Corporation of America
P.O. Box 6600
Buena Park, CA 90622

PETER HAMMAR

A Historical Perspective

(contued from page 39)

In 1985 we published this article on the birth of the video recorder. Who was its "Father"?

"AUDIO-FOR-VIDEO" has become a major development in the recording and production field during the past five years. Clearly, as a business and as an art form, audio and video are moving closer together. However, this "new" audio-video engineering synergy should come as no surprise. Both spring from the same source, audio. As a close relative, audio will want to share in an important birthday that video will soon celebrate, the introduction of commercial videotape recording in 1956.

Audio can take credit for being the "father" of other recording media, including magnetic recording. In magnetics, some of the people who originally made audio tape possible in this country and abroad also contributed directly to the creation of instrumentation, data, and video tape recording.

For example, John T. Mullin, the man who introduced Ampex and Hollywood to audio magnetic recording in 1946, developed the first working videotape recorder (VTR) prototype for the Electronics Division of Bing Crosby Enterprises in 1951. Mullin used a fixed-head, longitudinal-scan multi-channel format for his video recorder. To build the machine's transport, the Crosby engineers used parts from an Ampex Model 200 audio recorder.

Crosby sold his Electronics Division to 3M in 1957, which became their Mincom Division. Mullin joined 3M with the other Crosby engineers. In a bit of video-for-audio reverse engineering, they used the closed-loop capstan technology that Mullin had first developed for Crosby video as the basis for the transport of 3M's famous "M" series of studio audio recorders.

At Ampex, video was the figurative rib taken from the body of audio. Officially, members of the Redwood City video team that developed the first commercially successful VTR were listed as employees of the Ampex Audio Division, the name given on the cover of the "Preliminary Manual" for the machine. Ampex created a separate Video Division only after the successful introduction of the VTR in 1956.

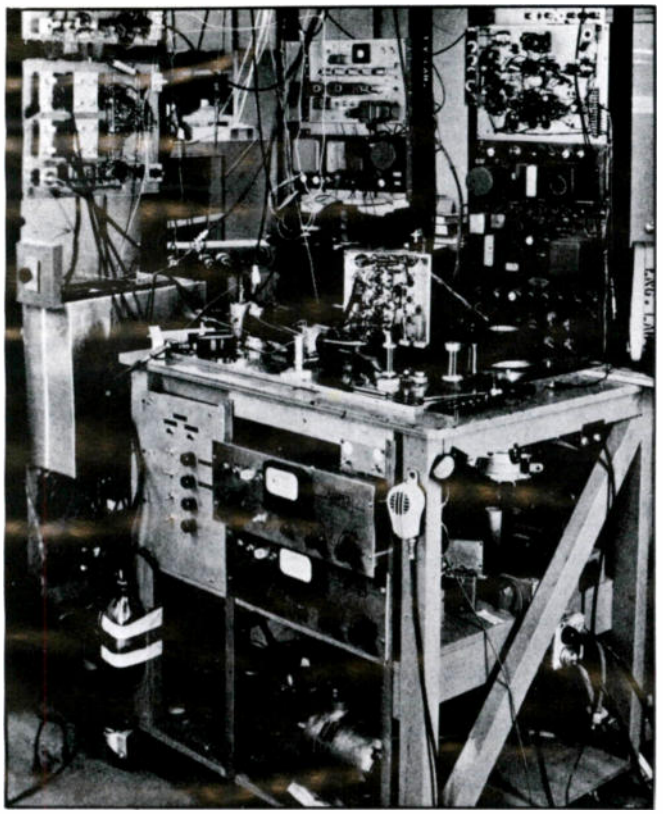
Peter Hammer waa the creator and curator of the Ampex Museum in Redwood City, CA at the time of this writing. Today he operates his own video studio in the California Bay area.

You will recognize another of the many audio connections in the development of video recording, Ray Dolby of audio Noise Reduction™ fame, who became the second person to join the Ampex VTR team almost at the inception of the video project. Dolby, not yet out of school at the time he began at Ampex, made major contributions to the development of the video recording art.

Next year marks the thirtieth anniversary of the event that has affected all of us for three decades—the introduction of the world's first practical videotape recorder, the Ampex VRX-1000. It was in April of 1956 that Charles Ginsburg and his five associates unveiled their invention at simultaneous demonstrations in Chicago and Redwood City. Unlike the fixed-head Crosby, RCA, and BBC videotape recorder prototypes, the Ampex VTR was the first to use spinning heads and slow tape speeds to achieve the high writing speeds necessary for video.

This Ampex VRX-1000 started a revolution in television production methods and programming.

The thirtieth anniversary of videotape recording



Prototype of the first commercially successful videotape recorder, the Ampex Mark III VTR in early 1955.

means more than one company's milestone. The event became a watershed in the history of television, creating a new kind of program production industry in a medium dependent on live stage methods and Hollywood film techniques. Besides color video, no single technology changed television as much as the magnetic video recorder.

Nineteen eighty-six marks the beginning of the fourth decade of change and innovation in television production. The arrival of digital audio and video, with the ability to manipulate picture and sound without generational loss, represents the greatest challenge for creative program production—and audio engineering—since tape arrived here after World War II. With audio-for-video, audio people are only now fully realizing the engineering and production opportunity that video tape created back in 1956.

Starting next year, I hope audio engineers will join their video brothers in taking note of the start of the truly remarkable technology of the VTR. The best way to mark the occasion is to renew our efforts at preserving both original television programming and the machines that recorded them. But we need your help out there in the field!

Many broadcasters and production studios have old two-inch videotapes that have been squirreled away in closets and on the bottom of tape library shelves. Some people don't realize that many of these dusty, old "quad" tapes represent rare, irreplaceable video footage showing the early days of the business.

I've met broadcasters and producers who assume that archives—somewhere, somehow—have copies of all

This is the first-ever videotape recorder prototype in 1951, built for Bing Crosby.

important television and radio material. In fact, the majority of videotape masters of both national and local programming have been erased or destroyed over the years. We should help preserve these very beginnings of the industry by encouraging broadcasters and producers who have old tapes to donate them to archives for high-quality transfer to modern media, as well as for preservation of the original tapes.

The Ampex Museum of Magnetic Recording, which is not an archive, can serve as a conduit to connect the holders of early video footage with archivists around the country. The major archives can offer proper legal cover for program donors, protecting the owner of the physical media who may be holding copies of programs not originally authorized for duplication twenty or thirty years ago. The fact is, with our cavalier, throw-away attitude towards preservation in this country, much of the programming that archivists have saved was originally "bootlegged" and held by private collectors. Meanwhile, the dumpsters of certain broadcasters, networks, and producers continue to overflow with our national entertainment heritage.

Although they may not own the content, private holders of original programming who want to donate and preserve tapes and discs can easily be protected from any supposed copyright infringement involved in a donation to a non-profit archive. The major media archives can also protect program producers, owners, and other equity holders such as actors and musicians. Much of this footage is vitally important in showing the birth and development of video tape, and simply must be preserved. We are looking for early black and white and color newscasts, network or local, and old videotaped programming from any market, large or small; any recordings of network feeds from 1957 to the early 1970s of either national news events or entertainment shows; any commercial spots, local or national, that may be sitting on a shelf somewhere. And don't forget kinescopes and old films made for TV!

Naturally, any important antique hardware and accessories, video or audio, should also be conserved for the future, if for no other reason than to be able to play back increasingly outdated video and audio recording formats.

Help us save an important part of our culture. Spread the word among your audio and video contacts about the kind of material we're looking for. When you find something, arrange for donation to the appropriate archive that will preserve the original and carefully make preservation copies. Or call me, Peter Hammar, at my office at (415) 941-0295 or at the Ampex Museum in Redwood City, California, at (415) 367-3127, for further reference.

Thanks to all of you, and happy birthday! ■

PETER HAMMAR and DON OSOSKE

A Historical Perspective

The Birth of the German Magnetofon Tape Recorder 1928-1945

This article is a revised version of one that first appeared in db in March 1982. With research assistance from German media historian Heinz Thiele, the authors have added new information obtained from sources that included BASF, AGFA, AEG-Telefunken, the German radio stations, the Deutsches Meseum and now long retired audio engineers.

THE DEVELOPMENT OF MAGNETIC recording was not exactly an overnight event. From its introduction in 1898 as the Telegraphone wire recorder to the controversy of today's digital technology, magnetic recording has gone through stormy times.

Peter Hammer waa the creator and curator of the Ampex Museum in Redwood City, CA at the time of this writing. Today he operates his own video studio in the California Bay area. Don Ososke was then with the Ampex Standard Tape Lab, and today operates an audio recording studio also in the Bay Area.

Valdemar Poulsen, the Edision of magnetic recording, invented almost every known form of magnetic storage. His first idea, in 1896, was a magnetic version of Edison's cylinder phonograph. Poulsen spiralled piano wire around a brass cylinder, with a laterally-moving magnetic pick-up head pushed along by the rotating cylinder. Playing time was thirty seconds. By 1899, the Dane had developed magnetic recorders that used spools pulling wire past the record head at two meters per second, with a recording time of several minutes. Poulsen

also made a machine that used a steel band to record sound. He even made a magnetic disc recorder whose pick-up head moved along a spiral guide, very much like the magnetic disc video slow-motion recorders developed by Ampex and others in the 1960s. And all this before 1900!

Unfortunately, marketing people regarded Poulsen's technical breakthroughs in magnetic recording as a curiosity, a toy. In 1905 the Danish engineer sold his Telegraphone patents to the highest bidder and went on to do research in other areas of electricity, including radio transmitters.

Lee DeForest, the inventor of the modern vacuum tube, wanted to perfect magnetic recording—many of DeForest's early Audion tube diagrams used a wire recorder as the theoretical sound source. However, DeForest's efforts were frustrated by lack of cooperation from Poulsen's successor, the American Telegraphone Company.

For shipboard radio recorders in the 1920s, U.S. Navy researchers Carlson and Carpenter improved the Telegraphone with vacuum tubes, and added something new to the record circuit—AC bias. But their Navy sponsors lost interest in communications recording and the two were forced to drop the project. Had the Navy had a bit more foresight (easy for us to say today), we might have had relatively high fidelity magnetic wire recording as early as 1923. The Navy's reaction reflected an attitude that continued from Poulsen's day: magnetic recording was more a curiosity than a practical tool.

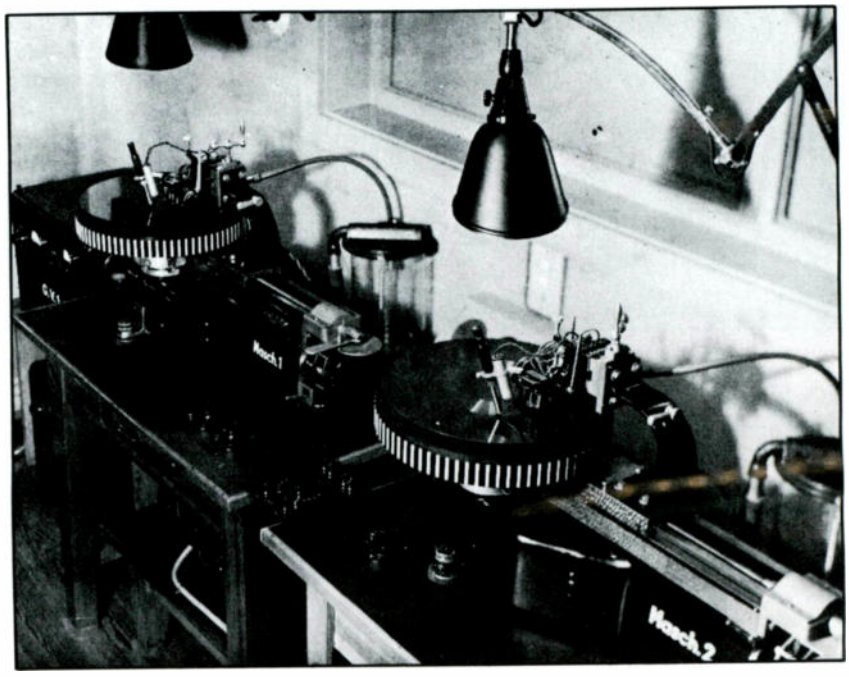
The next attempt to commercialize magnetic recording was made almost a quarter-century after Poulsen, when Curt Stille in Germany formed the Telegraph Patent Syndicate in 1927. Stille envisioned magnetic recorders for dictation, automatic telephone answering, and even music reproduction. None of the members of the syndicate was very successful in their attempt to commercialize magnetic recording, although the Lorenz Company in Berlin almost succeeded.

Around 1933, under the direction of S.J. Begun (who later headed Brush Development in Cleveland), the Lorenz Company began work improving one of Curt Stille's ideas, using a steel band as the recording medium. Lorenz had enough faith in magnetic recording to design its "Stahltonband Maschine" or "steel sound machine" for use in radio stations as a transcription device. In fact, by the mid-1930s, several European radio services, including the Germans and the British, had used steel recording on the air. Steel-band recorders had reached a quality level almost equal to the broadcast wax disc.

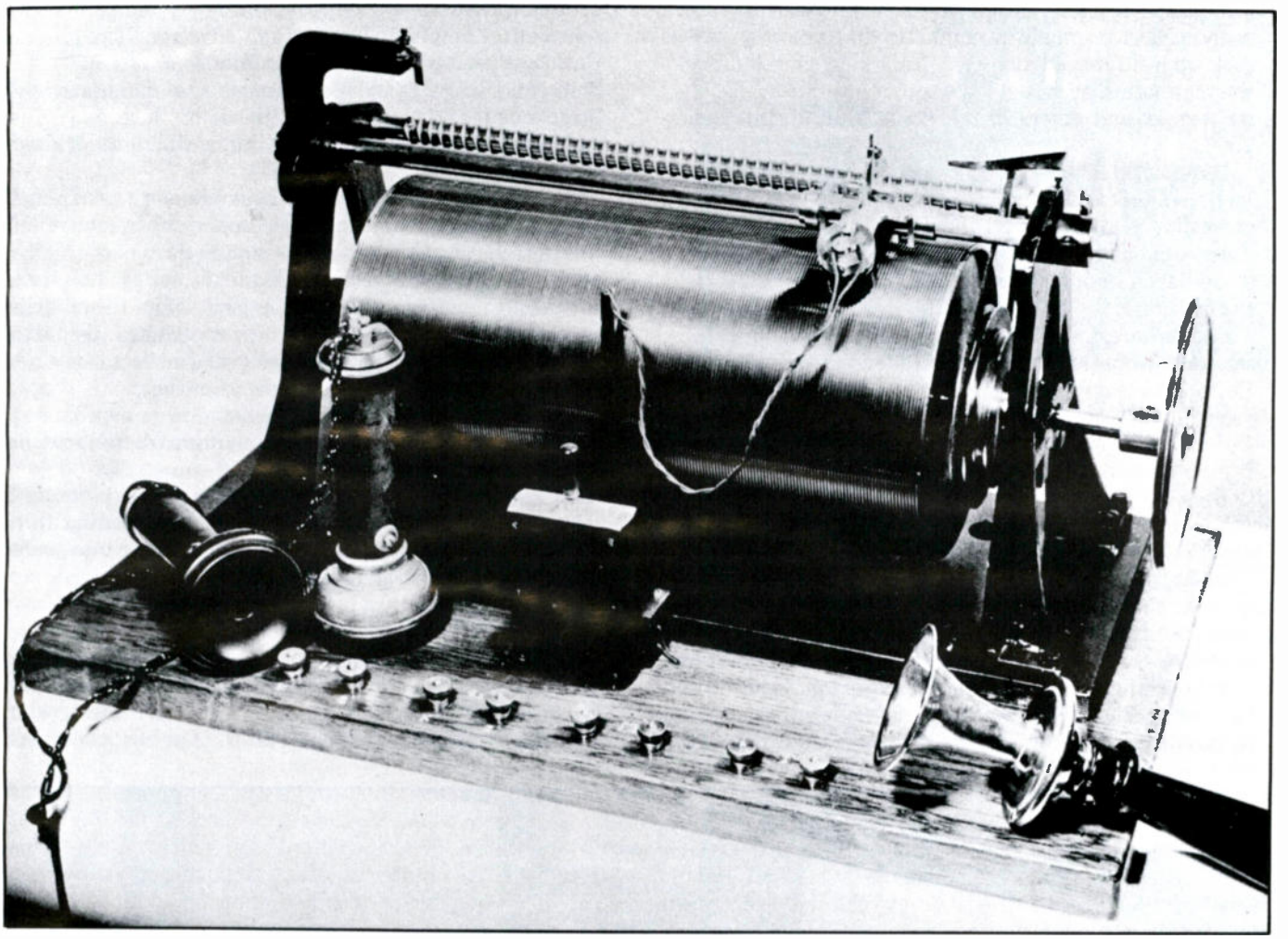
During the world-wide depression of the 1930s, people relied increasingly on radio at home for entertainment. For broadcasters, the Thirties was a time of tremendous growth in entertainment programming. Most radio stations used recording lathes to cut lacquer or very thick wax discs for use in time-delayed broadcasts. However, the wax discs could only be played two or three times before the grooves were worn. Also, the radio engineer could not easily edit a program recorded on a disc. The necessary disc-to-disc transfers to edit out mistakes led to high generational loss of sound quality.

Naturally then, magnetic recording on a long, thin strip of material offered the broadcaster editing and multiple-replay capabilities that he did not have with discs. But the Lorenz Company's steel-band recorder was out of date before they could get their machine to the broadcast market. Steel as a recording medium was impractical at best. You edited with solder and a welding torch. A fifty-minute reel of steel tape measured over two feet in diameter, and weighed almost 40 pounds!

The machines could even be dangerous for their operators. The English version, the Blattnerphone, used



Neumann wax disc recording lathes at Sender Hamburg in 1931. Recording lathes were the forerunners of the Magnetophon in German broadcasting. (Photo courtesy of the Norddeutscher Rundfunk Archives, Hamburg, Germany.)



The first Poulsen Telegraphone, circa 1898.

at the British Broadcasting Corporation until as late as 1950, was operated in a metal cage so that if the steel band flew off its reel during fast-forward or rewind, the engineer on duty wouldn't lose a hand, or worse.

The expense alone of solid steel tape was high enough to prompt the German radio service's chief engineer H.J. von Braunmuhl to look for an alternative to steel. There had to be a better answer to magnetic recording than steel band.

FROM STRAWS TO CIGARETTES TO MAGNETIC TAPE

In Dresden, Germany, the Universelle Company had been building cigarette manufacturing machines since the turn of the century. One of their engineering consultants in the 1920s was Fritz Pfleumer, whose previous discoveries included drinking straws made of plastic, as well as new forms of foam rubber.

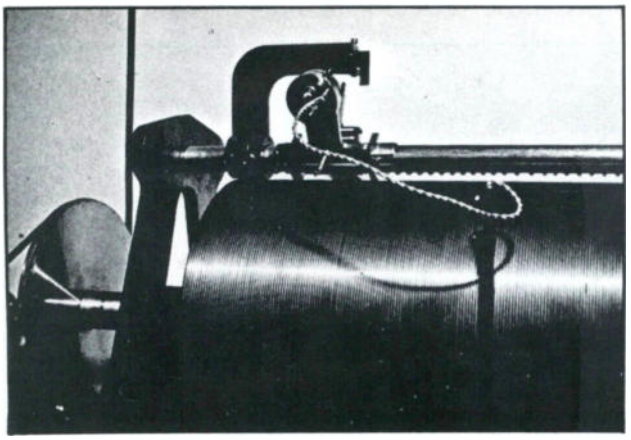
One of Universelle's machines was designed to make cigarettes with a thin band of real gold around the mouthpiece. Even for 1928, using gold on cigarette mouthpieces was becoming expensive, so the company put Pfleumer to work finding a substitute for the gold. Pfleumer developed a bronze powder that he mixed with lacquer, spread on a wide, long strip of paper, and then slit into tiny pieces for gluing onto the cigarettes.

Pfleumer was somewhat of an audiophile. He liked good-quality radios and recording devices, and did much experimenting on his own. Of course, like most engineers, Pfleumer knew about the wire Telegraphone and the early experiments with steel-band recording.

Around 1928, Pfleumer was in Paris on a business trip. While sitting in a cafe, he was thinking about magnetic sound recordings. He reasoned that, instead of using expensive, heavy steel tape for recording, he could use his cigarette-mouthpiece-label technique to make cheap, lightweight magnetic tape. Instead of bronze powder, iron powder could be mixed with lacquer and spread on a paper tape.

Pfleumer's combined knowledge of paper tapes from his cigarette work, and his understanding of magnetism and electro-acoustics was crucial to his success in making the world's first magnetic tape recorder. He knew, for example, that the iron particles had to be as small as possible to achieve the highest possible frequency response. For Pfleumer, the all-important binder material to glue the particles to the tape was no problem at all. He just used the same lacquer he had used for the bronze on the cigarette mouthpieces.

Pfleumer's first tape recorder, built in 1928-29, sounded just awful: distortion, background noise, wow, and flutter. But the point was, the thing *worked!* One did not need a solid piece of ferrous material to record sound magnetically. The engineer described his recording tape as "a 300-meter-long roll of the recording material which lasts twenty minutes and costs only one Mark 50 Pfennigs (about 25 cents) to make. The paper, called Pergamine, is only 0.04 mm thick." He pointed out that, with his new



Detail of the Telegraphone record/playback head. (Photo courtesy of the Deutsches Museum, Munich.)

recording system, the tape editor could trade his welding torch for a pair of scissors.

Unhappily for Fritz Pfleumer, the German patent office in 1936 denied him his 1928 patent, finding the American J.A. O'Neill's 1927 magnetic tape patent valid. As far as we know, O'Neill never did make workable magnetic tape or a recording device of any kind.

In 1929, Pfleumer took his invention from Dresden to Berlin, to sell it for development. Newspapers there ran stories about the new recorder, after several private demonstrations. AEG (*Allgemeine Electricitaets Gesellschaft*, or "General Electric Company") in Berlin, was Germany's second-largest electronics company, after the Siemens Company. AEG designed and manufactured professional and consumer electronic products, much as its business associate General Electric did in the United States.

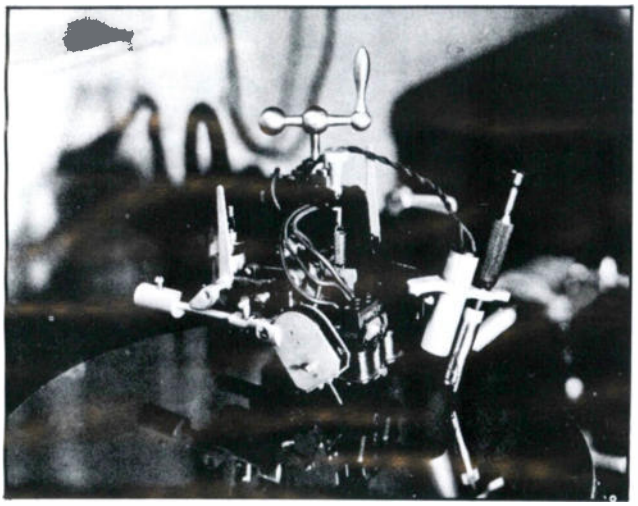
At AEG in 1930, Pfleumer's first demonstration of his tape recorder, which he called a "sound paper machine," was less than convincing. His magnetic recorder, like others before it, sounded poor. However, for the first time in history, engineers and managers were far-sighted enough to see the potential for tape recordings. By 1932, AEG had signed a contract with Pfleumer to buy his patent outright and develop tape recording.

The engineers at AEG tried to make their own tape at first, according to one account, buying carbonyl iron at the corner drugstore and spreading it on paper "ticker tape." The sound they got from the tape was terrible, and they soon realized that the problems of spreading thin coats of iron-filled lacquer onto strips of paper tape were best left to a chemical concern.

THE FIRST TAPES

In the early 1930s, the chief executive officer of AEG, Herman Buecher, heard about his engineers' problem. He called his old friend in Frankfurt, Carl Bosch, who was the head of the powerful IG Farben chemical

In 1938, the German radio or "Reichsrundfunk" became the first broadcaster in the world to adopt tape as its transcription and time-delay standard. Shown are AEG Magnetophon K-4 "HTS" AC-bias models at Radio Kiel, circa 1943.

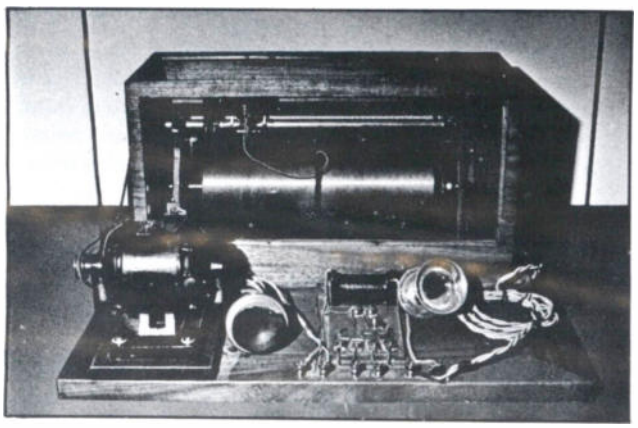


Neumann disc cutting head, in use circa 1931 at Sender Hamburg. Both wax and lacquer discs were used for the broadcast-quality recordings. (Photo courtesy of Norddeutscher Rundfunk Archives, Hamburg, Germany.)

combine, to see if the two companies could make the development of the magnetic tape recorder a joint venture. In 1932, AEG's Buecher and IG Farben's Bosch arranged for a member of the IG Farben group BASF, *("Badische Anilin und Soda Fabrik"* or "Baden Anilin [dye] and Soda Factory"), in Ludwigshafen, to begin intensive research into the problems of making good magnetic tape for the new AEG machine.

The first BASF tapes made in 1934 for the Berlin Radio Show was made of pure, powdered carbonyl iron. The iron, which looks like black dust, was mixed with lacquer and spread onto a cellulose acetate film, which was then cut into five millimeter-wide strips (6.35 mm = ¼ inch) several hundred meters long. BASF's first tape had no trade name, and was simply called "IG Farben carbonyl tape." Mechanical problems with AEG's prototype Magnetophon postponed the planned 1934 unveiling of the new recording process until the Berlin Radio Show the next year.

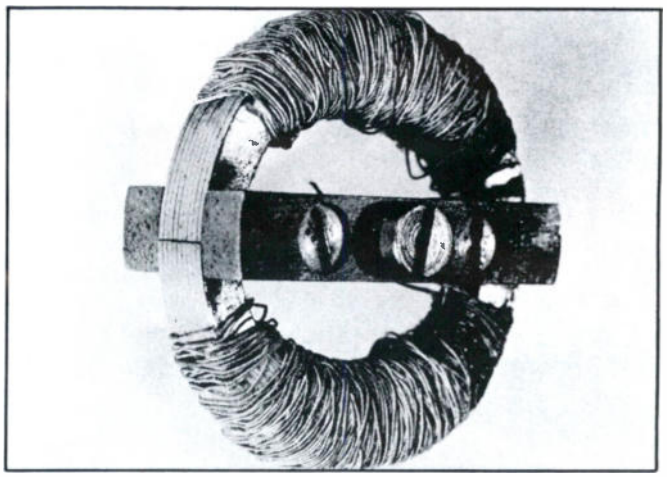
By 1935, the researchers at BASF had progressed from carbonyl iron to iron oxide with smaller magnetic particles that resulted in better electrical performance. Today's iron oxide tapes are essentially refinements of these early BASF formulations.



Poulsen Telegraphone, complete (1899). Poulsen intended this device—record/PB time = 30 seconds—to be an automatic telephone answering machine. (Photo courtesy of the Deutsches Museum, Munich.)

At the start of their joint venture with AEG, BASF switched from paper to a cellulose-acetate film. The early carbonyl iron tape was brittle, but much stronger than the first paper tapes. BASF's trade name for their acetate basefilm was "Cellite," so they called their new iron-oxide formula tape "Type C." Manufactured through 1942, Type C tape had a rust-colored oxide with a gray backing.

By 1943, BASF had introduced a third kind of tape. Luvitherm or "Type L," a homogeneous tape/basefilm of polyvinyl chloride. Though much stronger than the Type C acetate tape, the PVC did stretch. Type L tape was made by dumping the iron oxide into the PVC vat, and then extruding the mixture into a solid film. Because the iron oxide was mixed throughout the tape, Type L could be recorded on either side. Another IG Farben member, Agfa at Wolfen, later joined BASF in the production of



The first "ring head," invented by Eduard Schueller in 1932 at the Heinrich Hertz Institute in Berlin. Schueller joined the AEG Magnetophon team in 1933, bringing with him his ring head patent.
Photo courtesy of AEG-Telefunken Archives, Braunschweig, Germany.

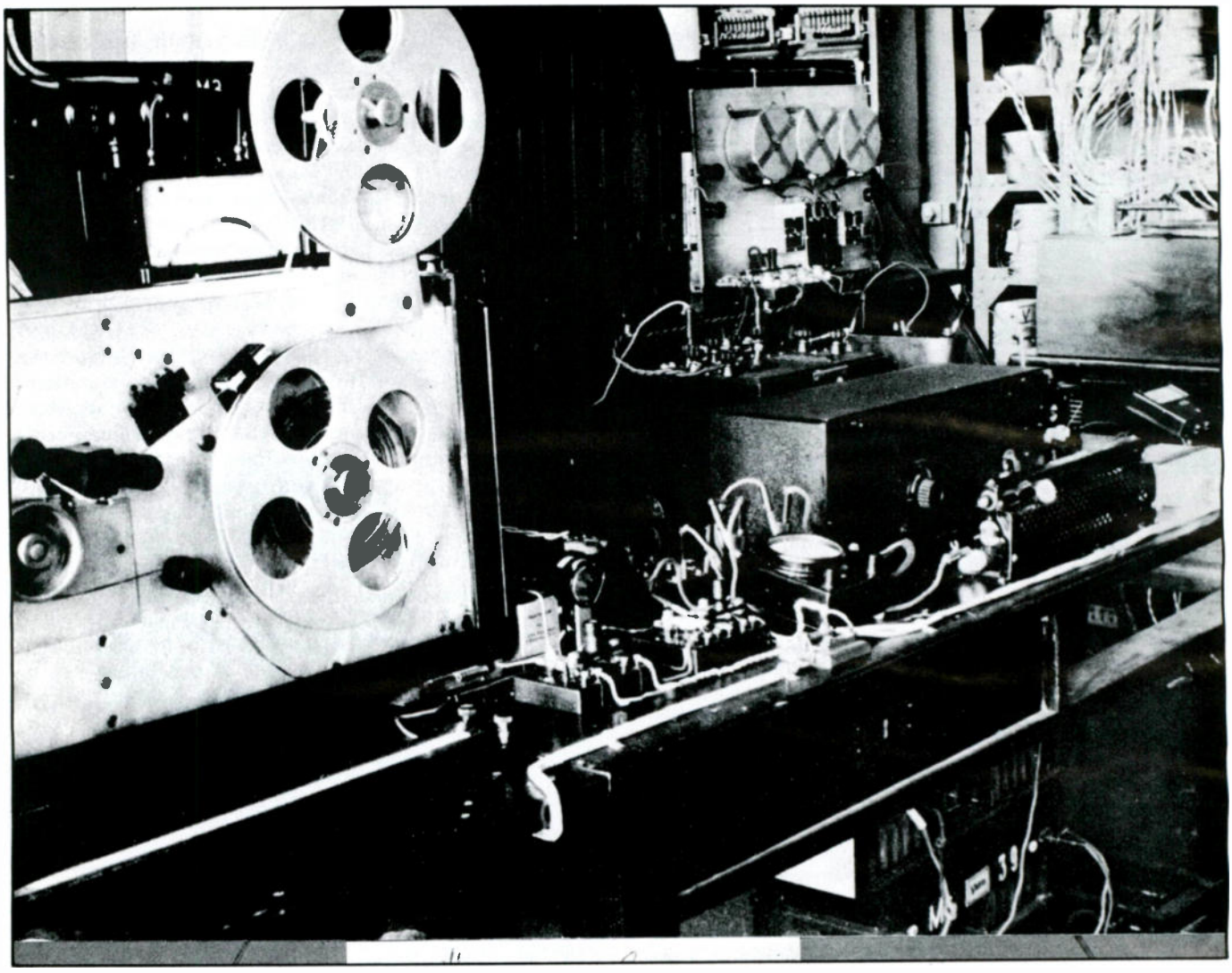
recording tape. In 1944-45, American GIs invading Northern Europe found a lot of Type L tape. Both BASF and Agfa were able to steadily increase their tape production until war's end in May of 1945.

The origin of today's one-quarter inch tape width standard came from a combination of good engineering and coincidence. In 1935, just before the introduction of the first AEG/BASF recorder and tape, the companies jointly decided to widen the tape from its original 5.0 mm to 6.5 mm (just a hair over one-quarter inch). The engineers chose the wider tape for greater strength and better electrical performance. We still do not know why they chose the number 6.5 mm.

When the Allied engineers examined the captured Magnetophons and their BASF/Agfa tapes, they measured the 6.5 mm width as a quarter inch, plus or minus "a tiny bit." The 0.15 mm difference between a quarter inch and 6.5 mm was really not worth noticing. With the interruption of German tape manufacturing at the end of the war and the importation of American 3M (Scotch), Orradio (Irish), Audio Devices and other tape, the official width of magnetic tape there became 6.35 mm as well.

THE MAGNETOPHON

Our thirty inches-per-second base tape speed also originated in Germany with the Magnetophon. Until 1935, the AEG/BASF R & D team used one meter-per-second as their nominal standard tape speed. However, the recorder/reproducer suffered from poor mechanical



The first laboratory prototype of the AEG "Ferroton" tape recorder in the fall of 1933. The one-motor machine used 5mm-wide carbonyl iron paper tape that was pulled past the heads at one-meter-per-second. (Photo courtesy of the AEG-Telefunken Archives, Braunschweig, Germany.)

performance. The selection in 1935 of a new AEG asynchronous motor for the capstan drive solved some of the problems. In an effort to simplify future production of Magnetophons and set a world-wide standard, the engineers specified a capstan diameter of 10 mm, ±0. A ten-millimeter capstan with AEG's asynchronous motor and the BASF tape produced a tape speed of 76.8 centimeters-per-second. If the production of the Magnetophons could be standardized, an odd tape speed really would not matter.

When Major Jack Mullin, one of America's tape pioneers, and his U.S. Army Signal Corps engineers measured the Magnetophon's tape speed, they were surprised to find it to be almost exactly 30-inches-per-second (76.2 cm/s). Mullin's Magnetophons inspired the creation of the Ampex Model 200, America's first commercially-successful professional recorder. In 1947, Harold Lindsay, the Model 200's chief designer, used Mullin's 30 ips figure in the American machine's design, which later became the U.S. standard. Mullin had lent Lindsay some of his precious pre-recorded Magnetophon tapes for test purposes, thus the logical choice of a 30 ips tape speed for the American machine.

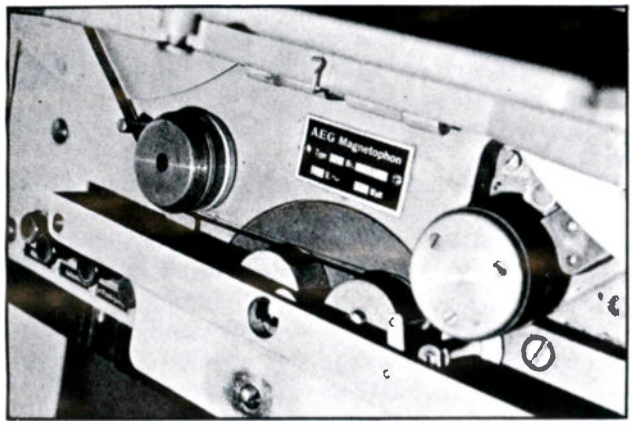
With the postwar dismantling of the Magnetophon factories, American machines dominated the European recording market in the early 1950s. The Germans adopted the U.S. figure of 30 ips, converting the number back to the metric 76.2 cm/s. No one ever seemed to notice the difference.

From the start of the Magnetophon project AEG faced the difficulty of building good heads. The heads originally developed by Poulsen and found on wire and steel-band recorders consisted of pole pieces with sharpened points pushed by springs onto the surface of the recording medium. Early experiments with the old-style pole-piece heads showed that these heads had electrical disadvantages. The magnetic lines of force from the pointed heads with their separate pole pieces were both horizontal (parallel to the axis of the tape travelling past it) *and* diagonal. The lines of flux which intersected the tape were unfocused and mostly ususable, even interacting with each other to create distortion.

THE RING HEAD

The solution was an invention by Eduard Schueller: the enclosed ring head. Schueller had worked as a research

assistant at the Heinrich Hertz Institute, a technical "think tank" in Berlin, and by 1932 was already experimenting with ideas of magnetic recording. Schueller found that the most important part of successful magnetic recording was the head. He decided to improve on the open pole-piece head design. The result was his experimental ring head. AEG soon offered



View of head assembly and tape path of AEG Magnetophon K-2 (1936), the portable version of the FT-2 shown on the March db cover. (Photo courtesy of AEG—Telefunken and Ampex.)

Schueller a key position on their tape recorder development team. Schueller's ring head created the nearly ideal magnetic flux pattern necessary for better fidelity recording. The lines of flux were concentrated in their most useful direction, horizontally (in the direction of the tape).

Thanks to the AEG-Telefunken Archives, BASF, the German Radio Archives in Frankfurt, and Hans Westphal of Berlin, we have copies of the earliest recordings made on the AEG prototype recorder in 1933. On the first recordings, the frequency response limit was not more than 3 or 4 kHz, harmonic distortion was about ten percent, and the signal-to-noise ratio was quite poor. By 1935, with the introduction of AEG's first production machine, the "Magnetophon K-1," fidelity had been increased, with frequency response to beyond 5 KHz and wit less distortion.

By 1935, the Germans had three of the four necessary ingredients of modern tape recording: 1) a stable transport, which the steel band recorders such as Lorenz had; 2) good tape, which the researchers at BASF had created; and, 3) the ring head from AEG's Schueller, with its good magnetic properties and gentle treatment of fragile tape. The fourth element of magnetic hi-fi recording, good electronics, would have to wait until 1939-40, after the Second World War had started.

From Valdemar Poulsen at the turn of the century until the late 1930's, direct-current biasing was the only method known to European engineers to reduce noise and distortion and increase frequency response. As late as 1939, the DC-bias Magnetophon sounded no better than an average 78 rpm transcription disc.

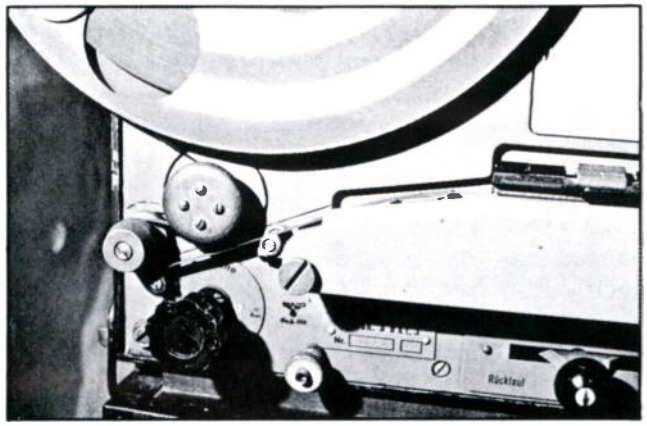
Although AEG initiated the development of the modern tape recorder, it may have been BASF that gave the machine its name. One of the names used by the engineers at AEG in 1932-33 for their new machine was "Ferroton." At BASF, they were calling their tape "Magnetophonband" or magnetic phonograph tape. The name stuck, and in 1935, AEG started calling the machine the "Magnetophon." The name is still used in Europe today.

Until 1945, most engineers around the world had not heard of the German tape recorder. It was the combination of DC bias and World War II that kept the Magnetophon in obscurity. Jack Mullin has said that, "Once you hear DC-bias recording, you'll never want to hear tape again!" Sir Thomas Beecham, having heard his London Philharmonic on tape in November of 1936, reportedly was so horrified by what he heard that he didn't use tape again until 1950.

In 1936, AEG sales people took their new Magnetophon to America for a secret demonstration at General Electric in Schenectady, New York. The DC-bias unit sounded so bad to the Americans that they decided that magnetic recording, at least in that form, was not practical.

The most promising market for the then-unperfected magnetic recording machine in Germany in the 1930s was the Berlin-based German radio monopoly, known as the RRG (*Reichs Rundfunk Gesellschaft* or "Empire Radio Company"). The chief of the RRG engineering section, H.J. von Braunmuhl, was against using magnetic recording for broadcasting. He liked the tried-and-true wax disc recording lathes with their Neumann heads. However, the progress of the AEG and BASF engineers interested him.

Von Braunmuhl bought several DC-bias Magnetophons and put his best engineer, Walter Weber, to work to see if the machines really could be improved enough to be used on the air. Meanwhile, the people at AEG was also hard at work trying to perfect magnetic recording.



Spinning head (4 gaps, 90 degrees to tape path) of Tonschreiber "Berta"; made by AEG, Berlin, circa 1939. (Photo courtesy of AEG—Telefunken and Ampex.)

Weber at RRG had an idea of how to improve the signal-to-noise ratio. He cancelled some of the noise by adding an inverting bridge circuit with a "dummy" record head to the record amplifier circuit. The resulting 180-degree phase shift reduced tape noise about three dB.

AC RECORD-BIAS

One day in 1940, Weber was experimenting with this circuitry, making recordings of music and speech as well as pure tones. Weber kept logs of which recorder he had used, time of day, and what he had recorded. Later, while playing back one of the tapes, Weber found that the sound was fantastic! He was hearing true high fidelity on tape: extended frequency response, low noise, and low

The disc transcription room, Sender Hamburg, circa 1935. (Photo courtesy of the Norddeutscher Rundfunk Archives, Hamburg, Germany.)

distortion. He traced the recording back to a Magnetophon that used his new noise reduction circuit, checked that circuit, and found that it was in constant oscillation, dumping high-frequency feedback into the record circuit. Weber realized that AC record-bias was *the* answer to hi-fi tape recording. He spent the rest of 1940 perfecting his AC-bias discovery.

After the boss of the AEG Magnetophon lab across town heard the results of Weber's breakthrough at RRG, he went to his own researchers and said, "What in the world have you guys been doing here, sleeping? Over at RRG, they've just discovered AC bias and turned *our* machine into a high-fidelity recorder. We've got to get on the ball here!"

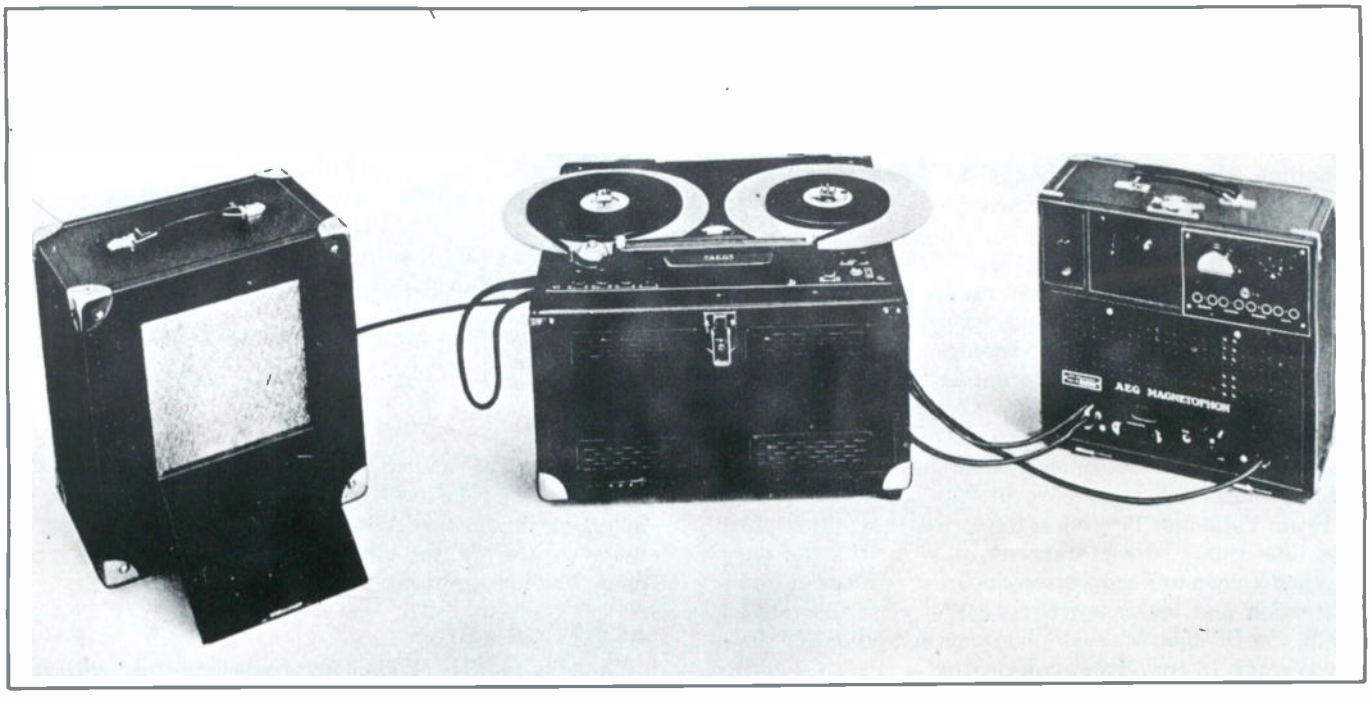
In fact, AC biasing of the record circuit was nothing new. But times were different, and engineers often missed each other's progress. Back in 1927, the U.S. Navy engineers Carlson and Carpenter, using a Telegraphone, had noticed the improvement of AC bias on wire recordings of telegraph messages. About the same time that Weber discovered AC biasing for tape recorders, Marvin Camras of the Armour Research Institute in Chicago had a similar discovery for use with his improved wire recorders. And before and during World War II, S.J. Begun of Brush Development in Cleveland applied AC bias to some of his wire and steel-band magnetic recorder designs.

With the war already in progress in Europe by 1940, it wasn't too surprising that Weber and Camras had not heard of each other's discoveries. In the late 1930s, the Japanese, under Kento Nagai, also discovered the AC-bias phenomenon on solid magnetic material.

After the war, the Allied Commissions in Germany and Japan declared all international patents of the Axis powers invalid. That left the quite advanced Armour patents as the finisher in the post-war AC bias license field.

For AEG, the beauty of Weber's discovery was that they could take their existing DC-bias design and simply add the relatively simple AC-bias circuit, while changing the record head only slightly. The playback of the DC-bias Magnetophon was quite good, although its full potential was never realized before AC-bias recording. The last production DC-bias Magnetophon had a specified frequency response of 50 Hz-6 kHz, a dynamic range of 40 dB, and harmonic distortion of 5 percent. The first AC-bias Magnetophon was rated at 40 Hz-15 kHz, with a 65 dB dynamic range, and under 3 percent distortion.

Most of the studio Magnetophons in use at the end of World War II were designed as early as 1938. The first



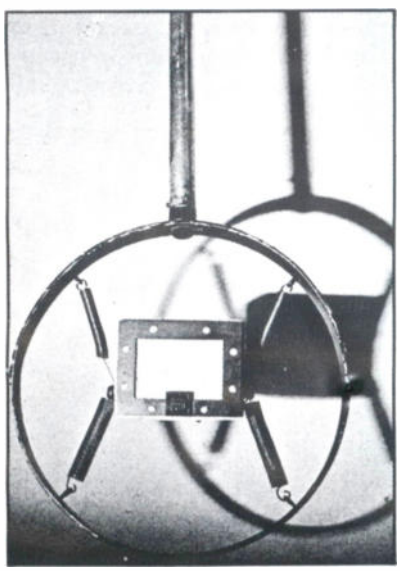
An AEG Magnetophon K-4, circa 1938. The DC bias version had a frequency response of 50 Hz-6 kHz, 5 percent distortion and a dynamic range of 40 dB. Once modified with Walter Weber's AC record bias, the frequency response improved to 40 Hz-15 kHz, with a 65 dB dynamic range and less than 3 percent distortion. (Photo courtesy of the AEG-Telefunken Archives, Braunschweig, Germany.)

production Magnetophon, the portable K-1, appeared in 1935. ("K" stands for the German word *Koffer* or "portable case.") The machine came in three cases, one for the transport, another for the electronics, and a third holding the loudspeaker. At the same time, AEG produced the cabinet "FT" series Magnetophon *Ferngesteuertes Truhe*, or "remote control cabinet"). The K-2 and FT-2 were introduced in 1936. The only FT-2 in existence that we know of is now a part of the Ampex Museum of Magnetic Recording in Redwood City, California.

The K-3 and FT-3 in 1937 were followed by the final Magnetophon in the pre-1945 series, the K-4, in 1938. The K-4 is the best-known pre-1945 Magnetophon. This is the machine that Jack Mullin and his partner, San Francisco filmmaker William Palmer, used to introduce America to the new technology of hi-fi tape recording.

The 1938 K-4 had DC biasing, and after the introduction of AC bias in 1941, a few early K-4s were updated. AEG also made an agreement with the RRG radio people to deliver K-4 decks built to RRG specifications incorporating the AC-bias design. The radio station console machines that Jack Mullin first saw at the Radio Frankfurt substation at Bad Nauheim in July in '45 werre special K-4 HTS ("Handgesteuertes Truhe Speziell," or "locally-controlled special cabinet" model).

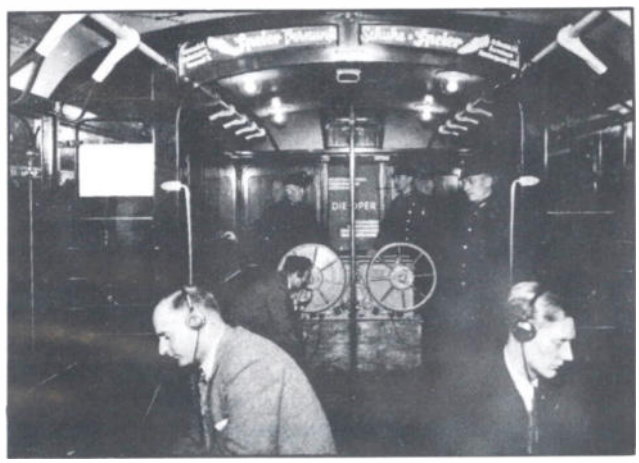
When the war started, everyone in Germany was ordered to switch over to building military products. That was as true for tape recorders as for coat buttons. AEG produced a very rugged, portable DC-bias version of the Magnetophon that they called the *Tonschreiber* or "sound writer." The best-known of the Tonschreibers was



Telefunken "Reisz" microphone, circa 1930, carbon-type, in solid markble housing, 50 Hz-6 kHz. (Photo courtesy of AEG-Telefunken Archives and Ampex Museum.)

the Type B, or *Berta* machine, which appeared in 1939-40. Berta was unusual because the machine had an extra, spinning head which could be used to compress or expand sound for high-speed transmission of information.

An amazing fact of World War II was that no one on the Allied side seemed to have heard about the hi-fi Magnetophons until the end of the war. This ignorance is even stranger when you consider that popular German magazines and newspapers, publicly sold in neutral Switzerland, printed numerous feature articles about German radio stations. Had the Germans classified all information about the AC-bias Magnetophons as "top secret," the Allied probably would have known about the machines before the end of 1940! As it was, they had to wait another five years.



October, 1934 Sender Hamburg remote broadcast recording on a Hamburg commuter train, using the Lorenz Steeltone machine. (Photo courtesy of the Norddeutscher Rundfunk Archives, Hamburg, Germany.)

During World War II, the Allies were sometimes confused about Hitler's location. Live-quality broadcasts of his speeches simultaneously came from all parts of Germany. The Allies suspected some sort of high-fidelity recording device, but they overlooked the fact that the Germans had an extremely advanced radio network. A complex web of high-quality land lines (10 kHz bandwidth, 600 ohm balanced line, less than 1 dB loss per 1000 km) allowed remote broadcasts from any location to any other location. In addition, time delay broadcasts had been standard procedure in Germany since the mid-1920s. To this day, old RRG engineers are amazed and baffled to hear that Americans thought that the Magnetophons were being used to deliberately confuse the Allies as to the location of high Nazi officials.

In England between 1942 and 1944, Major Jack Mullin and others had been hearing late-night German broadcasts of live-quality orchestral music. Mullin thought that even a madman like Hitler could not compel tempermental musicians to play at three a.m. However, the audio quality of the transmissions was much better than any recording device Mullin knew. What he heard was the routine use of the Magnetophon, which had been developed as a professional and consumer entertainment device.

The Magnetophon tape recorder naturally got sucked up into the German war effort. The chief of the AEG Magnetophon lab during the war, Dr. Hans Schiesser, said that he had received specific orders from the Nazi government to work exclusively on the DC-bias military Tonschreibers for use by the army, air force and navy, and to ignore further civilian tape recorder development until after the war. However, Schiesser kept a secret set of lab notes in which he wrote of his work on high-fidelity magnetic recording, including experiments with stereo record and playback heads, which he quietly did on the side at some personal risk. For Hans Schiesser and many others at AEG and German Radio, the Magnetophon tape recorder was the exciting way into the future of high fidelity reproduction of sound. ■

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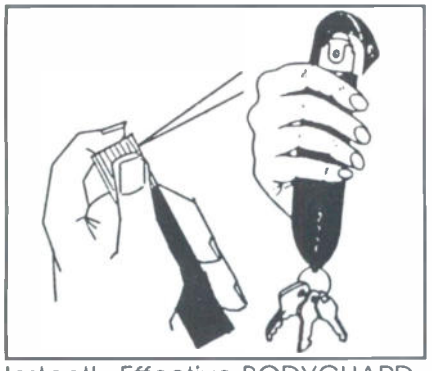

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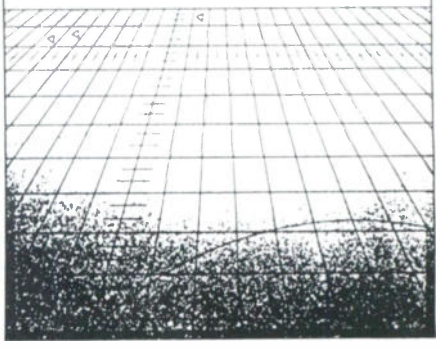

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(PPH continued from page 66)

completion and comprehensive testing for audio speaker designs which incorporate ferrofluids. For the United States, **Richard A. Powlowsky** has been appointed sales manager for the domestic market and is also the primary representative domestically to the **FerroSound** program.

• **Telarc International** received a **Grammy** award for the "Best Comedy Recording" category and it was for an unprecedented fourth year in a row. The Cleveland, OH based company has won twenty-seven awards since 1980. The 1993 winning record was **Peter Schickele's PDQ Bach: Music for an Awful lot of Winds and Percussion** and at the time of the award was on the top 15 on **Billboard's** Classical Crossover chart.

• **Otari Corporation** announced the establishment of a direct sales office to be located in New York City. The office will have direct end-user sales for the DTR-900, MTR-100, MTR-90 and ProDisk 464. The area covered will be the Boston, New York, Philadelphia and Washington DC. The official title for the office is "Otari North East Regional Direct Sales Office" which is being abbreviated as ONE. Technical support that ONE sells will be supplied by two different companies. The MTR-90, MTR-100 and DTR-900 will be handled by **New York Technical Support, Inc., Greg Hanks** owner. He can be reached at 212-246 0227. The Pro Disk will be handled by **Film-Tek and Associates, Inc., Laslo Katona** and **Vince Mosdar** are owners. They can be reached at 201-797 4999.

• **Jon Anderson** of *Yes* has purchased **Digital Designs** speakers for his studio. Yes, based in California works with holographic images. He felt that using Digital Designs speakers creates rel hi-fidelity sound in my room, they are crystal clear and resound on every level from quiet to really "blasting."

• **Steve Rainford** has been named by **Solid State Logic**, Inc. as Digital Products Training Manager. Rainford will be based in SSL's U.S. headquarters in New York City. Steve Rainford comes to this position with many years experience in the post production industry. He has been a free lance post-production engineer at **Teletronics** and **MTI** and he utilized SSL's ScreenSound in the digital editing/pre-mastering process on George Harrison's recent live album, which was mixed at **The Mill Studios** in England.

• A nationwide leasing arrangement with audio/video lease specialists **L.F.C.I.** is currently available for the **Nagra-D** digital recorder. Also available for lease through L.F.C.I. is Nagra's **T-Audio** and **IV-S TC** recorders. L.F.C.I. is based in Clinton Ohio and is offering a number of lease options to suit different needs, from True Lease Option which allows the lessee to claim rental payments as tax-deductible, to the Equity Lease Option which offers a fixed dollar buyout of less than 10 percent. For more information on leasing the Nagra-D recorder, L.F.C.I. can be contacted at 800-626 5324.

PEOPLE, PLACES & HAPPENINGS

• **The Special Collections Department** in the **Pullen Library at Georgia State University** is preserving volumes of rare, deteriorating audio recordings of local Georgia radio broadcasts. A grant of $22,244 by the **National Historical Publications and Records Commission** has enabled the department to establish a rerecording lab, expand its collection of recording and playback equipment and make preservation-quality tapes of aging archival audio recordings. The recordings include radio programming from the 1940s and 50s and unique, unpublished recordings relating to the career of the late songwriter, **Johnny Mercer**, who came from Georgia.

• Focusrite, a company based outside of London, has appointed Group One, Ltd. of Farmingdale, NY as its official distributor. The British company is a manufacturer of recording consoles and signal processing equipment.

• **Ron Sauro** has joined **Renkus-Heinz** of Irvine, CA in the newly-created position of Engineered Systems Manager. His primary responsibilities will be related to the sale of the EASE, EASE JR and EARS acoustical design programs. He will also assume the responsibility for the ongoing development and training of the company's nationwide network of engineered system contractors. Ron's extensive background in music and electronics is based on having operated his own company for the past twenty years, specializing in sound-system design and installation.

• **The 3M Company** has announced that it is establishing the first San Francisco Bay area facility to manufacture CD-ROM and it will be called **Just-In-Time** (JIT). Located in Fremont, the facility currently under construction is scheduled to begin production by the second quarter of 1993. The close proximity to Silicon Valley will enable them to reduce the turn around of their customers to only few hours. In addition to manufacturing, the new plant will offer packaging, distribution and fulfillment services for CD-ROM content producers. They will also continue to offer full services at their Menomonie, Wisconsin plant.

• **Bruce M. Merly** has been appointed to the newly created position of General Manager of **Howard Schwartz Recording**, Inc. **Howard Schwartz** explained that because of the technology explosion, the direction of the recording company has been changing on an almost daily basis. With the many options available by the company, a person was needed to maintain constant contact with their clientele. Bruce Merly has been Chairman of the Board and President of **SPARS**. He also has been president and general manager of **Clinton Recording Studios** in NYC as well as consultant in this industry.

• A new company, **Pioneer New Media Technologies, Inc.** has been formed by joining **Pioneer Communications of America**, Inc. and **Pioneer Laser Entertainment, Inc.** The new company will be headquartered in Long Beach, CA. The charter of the new company includes the development, marketing, sales and technical support of LaserDisc players, LaserBarcode readers, CD-ROM minichangers, cable television addressable converter systems, LaserDisc pay-per-view systems, WORM and multifunction drives, projection CUBE systems, rewritable videodisc recorders, LaserKaraoke entertainment systems, Star Factory karaoke studios, professional audio components, compact disc autochangers and LaserJuke CD jukeboxes.

• **Art Kelm** has been appointed as the new Director, Technical & Engineering by **Record Plant, Hollywood**. He will be responsible for all technical, engineering and systems related areas of the Record Plant's four-room operation, and will handle day to day management of the technical department. Art joins Record Plant from **Disney Imagineering Circlevision** project. He has served in management positions at various Los Angeles facilities.

• **Scott Bowden** has been named International Sales Manager for the **Fluids Technology Division** of the **Ferrofluidics Corporation**. Bowden will oversee the sale of audio ferrofluids to loudspeaker engineers and manufacturers throughout Asia, Europe, Canada and South America. He will be the primary contact to the FerroSound program, which is a customer support program for speaker manufacturers. FerroSound also offers customer assistance from the early stages of product development to

(continued on page 65)

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