IN THIS ISSUE:
- Studio Insulation
- Home-Brew Multi-Media
- Interview: AMPEX ATR-100 Part II
OTARI MX-5050 the original (and still the best) compact professional recorder

Just over two years ago, Otari introduced a unique new product—the first truly professional recorder in a compact package—the MX-5050. Since then, the performance and reliability of this innovative new machine have been tested and proven in over a thousand critical professional applications—by broadcasters, recording studios, A/V departments, musicians, and semipro recordists worldwide. Universal acceptance and repeat orders by these satisfied customers tell this remarkable recorder's success story better than we can.

Production Features: Creative production is simplified with:
Front panel edit to spill tape,
Lift-up head cover to mark splices and clean heads. Built-in splicing block on head cover, Adjustable cue to defeat head lifters. Selective reproduce to add new tracks in perfect time synchronization.
Two speed operation, 15 and 7½ or 7½ and 3¾ ips (field changeable in c-c servo versions).

Performance Features: Headroom is 19 dBm, a full 15 dBm over the switch selectable fixed output of +4 dBm. This standard reference level output can be rear panel switched to −10 dBm to drive a PA system or power amplifier.
S/N ratio is NAB weighted 69 dB full track, 68 dB half track, and 65 dB quarter track. Crosstalk is greater than 60 dB half track. Outputs are 600 ohm balanced (standard on half track) or unbalanced. Line input and output connectors are XLR.

Operating Features: Bias is front-panel continuously adjustable (not limited to fixed positions). With built-in test oscillator (not available on other compact professional recorders) bias can be optimized in seconds when changing tape. Record EQ and standard reference level are also front adjustable. Straight-line tape path simplifies threading. Capstan is located on back side of tape for improved tape life. An extra reproduce head is standard on all versions to allow playback of tapes in different formats.
For pitch control and freedom from power line variations, an optional dc capstan servo is available with ±10% correction range.

Versatility: Available in full-track (with half-track reproduce capability standard), two-track, and quarter-track versions. Walnut case (standard), rugged portable road case, rack mounting adaptor, or floor console. Universal power supply standard. Low impedance input and output transformers and remote control also optional accessories.

See your nearest Otari dealer for the full story or contact Otari. And, if it's multichannel you need, ask about the standard-setting four and eight channel versions of the MX-5050.

Otari Corporation
981 Industrial Road
San Carlos, Calif. 94070
(415) 593-1648 TWX: 910-376-4890

Otari Electric Co., Ltd.
4-29-18 Minami Ogikubo
Suginami-ku, Tokyo 167, Japan
(03) 333-9631 Telex: J26604

Circle 10 on Reader Service Card

www.americanradiohistory.com
A viewpoint on the right kind of reverberation to use is discussed in an article by William H. Hall.

A good low cost oscillator is a must in many aspects of studio setup and operation. Evert Fruitman has contributed a construction article for a low-distortion single frequency oscillator that you can build for around ten dollars.

At the other end of the measurements scale can be found the Sound Technology 1710A. This combines in one package a wide-range, low-distortion oscillator and a harmonic analyzer as well as an optional intermodulation analyzer. We will have a test report on this remarkable and versatile tool.
dbx your Dolby “A” and eliminate ALL the hiss

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It's a direct plug-in replacement for the Dolby “A” CAT-22 card. It interchanges instantly with no adjustments. It gives you the flexibility to use both dbx and Dolby “A” formats with your existing Dolby main frame. It provides more than 30dB noise reduction and 10dB extra headroom. It eliminates the hiss which remains with Dolby “A”. It gives greater than 100dB dynamic range. It requires no level match tones. It's affordable. It costs only $250 per channel, or less than half the cost of a free standing noise reduction system. It can go wherever you go in its optional Halliburton travel case. It's the new world standard in noise reduction. It's available now from your dbx dealer whose name we'll supply along with complete product information when you circle reader service number or contact:

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Fleximix is designed for high quality Public Address, Bands, Recording Studios and Theatre applications and many of its features are normally only to be found on expensive studio consoles.

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Tel: (213) 990-5955
Contact: David Michaels.

Audiotechniques Inc.
342 Hamilton Ave.
Stamford, Conn. 06902
Tel: (203) 359-2312
Contact: Adam Howell.

Circle 19 on Reader Service Card

www.americanradiohistory.com
Now relax, playfully invite your muse, and transform these tracks, adding body, stereo perspective, flanging, and a host of other time-base effects. Since Lexicon introduced digital delay over six years ago, most studios have come to depend on it at least for doubling and slap. Now, the stereo 102-S with the new VCO module* produces many other effects, including more natural double tracking, flanging, vibrato, time delay panning, extreme pitch modulation, and signal transformation for special effects. Of course, you can also use the two channels for completely independent processing.

The Lexicon Delta-T has earned an enviable reputation for its 90 dB dynamic range, impeccable audio quality, high reliability, and functional modularity. All this is retained in the new 102-S, while two channel operation, finer delay steps (3 ms), and the VCO have been added. And the 102-S is economical. Its totally modular construction allows you to start with a bare bones mono system and expand later as needs and budget grow. We'll help you define the configuration you need to get started. Call or write Lexicon for further information.

Write on your letterhead for AN-3, Studio Applications of Time Delay. A 30-minute demo tape is also available for $1 in cassette, or $5 on 7 1/2 ips/2 track tape.

*The new VCO module also fits any 102-B or C mainframe to enhance its time-base signal processing capability.

The Editor:
Would you please print the following message in your Letters column.
Dear Friends of Audio:

I am in charge of developing a student audio engineering library. If you have any literature concerning audio engineering, electrical engineering, music, physics, or other subjects appropriate to audio that you no longer use, their donation would be greatly appreciated.

Usable printed matter would include periodicals such as db, A.E.S. Journals, Audio, RE/P, Studio Sound; textbooks; service manuals; charts or photographs. Out-of-date or obsolete materials all have their value in student learning situations and most anything will be welcome.

Thank you for your interest in promoting audio education.
The Student Library
c/o T. W. Woynicz
P.O. Box 7347
Hollywood, Fla. 33021

CALENDAR

MARCH


14-17 NOISEXPO '77, the National Noise & Vibration Control Conference and Exhibition. Holiday Inn, O'Hare/Kennedy, Chicago. Contact: NOISEXPO '77, 27101 E. Oviatt Rd., Bay Village, Ohio 44140. (216) 835-0101.

The mixing links.

Now! Two new tools for even greater versatility, and economical expansion of SR Sound Systems: The compact SR109 Professional Mixer gives (or adds) up to eight microphone channels, each with individual gain control and high/low frequency equalization—without cramping your budget. Adjustable peak limiter with LED indicator prevents overload, and a peak responding LED indicates output clipping level. Built-in tone oscillator, headphone output and illuminated VU meter. Takes only 5¼" rack space. The SR109 can be connected to one or more SR110 Professional Monitor Mixers for monitor (foldback) mix, or for adding stereo output capability.

The SR110 features an eight-channel input/single output design—can be used as a single unit mixdown panel, or stacked for multi-channel recordings (use four for quadriphonic) or stereo broadcasts. Super space-saving—takes only 1¾" rack space. Both units are ideal for use with the SR101 Series 2 Console.

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Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

Circle 15 on Reader Service Card
AND NOW, A WORD ABOUT OVERLOAD, FROM SENNHEISER’S MD 421:

NONE.

A lot of engineers are worried about overload these days. And no wonder: Rock groups. Country groups. Jetports. And other high program and ambient sources make it more necessary than ever for microphones to be overload-free as well as accurate.

Like our tough MD 421 cardioid dynamic.

In this test with a starter’s pistol, we measured an instantaneous sound-pressure level of some 175 dB — well beyond what any musical instrument or voice can produce — while the oscillogram measured no clipping or ringing.

Whether you need a microphone to capture transient sound like this pistol shot, or “face the music” on stage at 130+ dB in a disco or recording session, consider our MD 421. You’ll discover its precise cardioid directionality, rugged design and wide, smooth response are ideal for rock-concert, recording and broadcast applications.

The price won’t overload you either.

*Outdoor test with Tektronix scope, set for 10V/division vertical, 01 μsec/div horizontal, 22 cm starter’s pistol mounted 15 cm from MD 421 measured pressure of 111,000 dynes/cm² (175 dB SPL). Smooth. rounded scope trace indicates total lack of distortion.

SENHHEISER ELECTRONIC CORPORATION
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Manufacturing Plant: Brederveld, Hannover, West Germany

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calendar (cont.)

22-24 Three-day course on Audiology and Hearing Conservation in Industry, Rensselaer Polytechnic Institute, Troy, N.Y. Contact: Office of Continuing Studies, Rensselaer Polytechnic Institute, Communications Center 209, Troy, New York 12181. (518) 270-6442.


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RF Tuned Circuits and Audio

- A considerable amount of audio is carried on rf transmission systems. Once the audio gets into the rf arena, it must contend with many factors that are not present in an audio-only situation. These rf factors can shape and distort the audio so that what is recovered at the receiving end of the system can be far different than what went into it. We will discuss one of these factors, the rf tuned circuit, and some of the effects it can have on the recovered audio.

CARRIERS AND SIDEBANDS

The rf signal is a carrier only, usually called simply, the carrier. This is the rf frequency assigned to the station or for a particular use. The rf carrier is generated and amplified to the value necessary to radiate it from an antenna (in an open circuit situation, such as broadcast) or over a cable system (as in a closed circuit situation). The plain carrier by itself is of little practical value.

Intelligence signals are impressed on the carrier in one or the other modulation methods. In the amplitude modulation (a.m.) process, the audio signal all goes into the sidebands. In standard a.m. broadcasting, there are two full sidebands. There are also variations of the a.m. process, such as vestigial sideband transmission as used for the visual carrier in t.v., single sideband as used in communications systems, and double sideband-suppressed carrier as used in communications and stereo multiplex.

Audio which modulates the carrier’s frequency or its phase is called frequency modulation or phase modulation. These modulation processes not only create many sidebands, but they also cause the carrier to deviate, or swing from its normal resting (assigned) frequency, in accordance with the audio modulation signal. This is a more complex situation since the carrier is constantly changing its frequency position.

A modulated carrier takes up more spectrum space than does an unmodulated carrier. Signals occupy space (in frequency) both above and below the carrier frequency. This space is called the bandwidth of the signal. Any circuit then, which carries this modulated signal or is to amplify it faithfully, must have adequate bandwidth. In other words, the circuit must be broadband enough to pass the signal and its sidebands.

TUNED CIRCUIT

Circuit elements contain inductance, capacity, and resistance values that become more critical at rf frequencies. The higher the rf frequency, the more critical and important these elements become. Besides actual tuned circuits, these same elements are found in conductor lengths, transmission lines, and the antenna itself. The higher the rf frequency, the more peculiar these elements act. The inductive and capacitative reactances and the rf resistance will affect the signal, each in its own way.

In a given situation, the reactive components (which are opposite in sign) will equal each other and cancel out their effects—leaving only the resistance in the circuit. (The reactive components are still present, but they are counterbalanced by each other.) This is the natural resonance of the circuit. Circuit gain will increase tremendously, limited only by the resistance in the circuit. The bandwidth of this resonant point is also very, very narrow.

Figure 1. When modulation is applied to a carrier, sidebands are created which widen the spectrum space occupied by the carrier. (A) is an unmodulated carrier while (B) is f.m. modulated.
Once is enough!

Water is pure and clear. Still, if we look at a leaf which is partially submerged in it, the leaf looks distorted. It is surprising how easy it is to introduce distortion, even by the simplest type of operation on the real thing. The bent leaf doesn't really bother us very much, but when distortion in sound results from the use of equipment, this bothers us a lot!

Some OTARI specialists spend most of their day making sure that the equipment that we produce has the lowest possible wow and flutter, and the highest possible S/N ratio. Naturally, these are not the only features which create the top performance of OTARI products, but they reflect the care that results in a totally balanced OTARI product, and better service.

Trust through experience — one encounter with OTARI equipment and from then on, You will trust the OTARI name.
Some time ago (longer than I’ll admit to here), I received a letter from Benjamin Homenick, who described himself as, “a semi-novice, not withstanding the implications of a half-empty or half-full glass of water, seeking the ‘truths’ about grounding and shielding, stereo and quad imaging, audio schools, etc.”

Needless to say, each of these “truths” could take (and has taken) many pages to discuss. But before dealing with some of Mr. Homenick’s specific questions, what about the “semi-novice” in general? It’s just one more term to describe that intriguing phenomenon known variously as the “low-end professional,” the “high-end consumer,” the “crossover customer” and finally, the “semi-pro.” To me, “semi-pro” seems to say it best; he’s the customer (now there’s an important word) who is not quite ready to spend some five kilo-bucks for a two-track tape recorder, yet who wants something more than he sees—or hears—in a $500 machine. And for him (and her), an entire “crossover” marketplace is rising, and the word has nothing to do with loudspeakers. It refers to the fact that many manufacturers see this customer as one who is crossing over from a high-fi-type of interest to a more serious involvement with the hardware of recording.

Like the customer himself, many manufacturers are also crossing over from their traditional places in the market. For example, manufacturers of both professional and consumer-type equipment are expanding their product lines to include hardware that should appeal to the customer who finds himself with more enthusiasm than cash—that is, the semi-pro.

Which brings us more or less to one of the points raised in Mr. Homenick’s letter: “Much of this (semi-pro) equipment serves admirably, but lacks ease of patchability. I know you ‘get what you pay for,’ but does this sentence me to a lifetime of connecting and disconnecting phono-type jacks and plugs from the back of a console with a dentist’s mirror?”

**PHONO-CONNECTOR JACK BAY**

Well, you may be condemned to a life of phono connectors, but thanks to TEAC, you can chuck your dentist’s mirror. They’ve recently introduced a rack-mountable phono connector jack bay, with row upon row of RCA-type jacks, on both the front and rear of a 19 in. panel. The idea is for you to connect the rear jacks to your equipment and then, via the front jacks, do your creative patchwork.

But that’s not exactly the end of the problem. Mr. Homenick—as well as others—is concerned about the practical significance of balanced and unbalanced lines, as well as the matter of impedance and cable length. (And here’s where the line between pro and consumer really gets stretched.)

Neither TEAC—nor the other manufacturers—can do much about the realities of electronics. To make a very long story overly short, you do get what you pay for, and balanced low impedance lines = $$$$. The advantages are greater noise immunity and less degradation of high frequency response, even with cable runs of hundreds of feet.

Although the unbalanced high impedance line is certainly no problem in the typical high-fi system, the trouble begins as the system expands into a semi-pro recording complex. Remember, unbalanced lines are potential noise makers, and high impedance lines must be kept short, if you care about frequency response. So, the unbalanced, high impedance patch bay can become a disaster area if you attempt to push it beyond its capabilities. It’s really almost as simple (and depressing) as that. To help
Soul trio in Studio A. Beethoven's 5th in B. Rock concert in the park.

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The best multichannel audio recorder in the world is also the most versatile. It handles 16-inch reels of two-inch tape for 16 or 24 channel work, and does a beautiful job with an 8-track head and one-inch tape. It'll give you the flexibility to record a vocal quartet one day, and a full orchestral ensemble the next.

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the sync track (cont.)

keep your aggravation at a minimum, don't use the patch bay we are describing in low level (e.g., microphone) lines, for any noise generated therein will be amplified by the entire signal processing chain—often with spectacular results at the speaker. (By the way, don't wear headphones while patching, unless you are already stone deaf.)

Remember, as you purchase, install and use semi-pro equipment, that prefix signifies two things; somewhat less cost, and somewhat less flexibility than full-professional hardware. If you operate the equipment within its limits, it will perform admirably. But if you try to push it, it may balk.

CABLE LENGTHS

The whys and why nots of balanced lines have been explained elsewhere many times, but maybe a word or two on the subject of cable lengths can stand repeating here. The reason for the high frequency fall-off in high impedance lines is reasonably straightforward. All cables have a certain amount of capacitance per unit of length. Therefore, the longer the cable, the greater the capacitance. Since the capacitance is, in effect, across the audio line, it acts as a high frequency roll-off filter. If the line impedance is low, the roll-off occurs far beyond the audio bandwidth. However, in a high impedance line, the effect of the high frequency fall-off becomes apparent well within the audio frequency range. Therefore, high impedance lines must be kept short, so that capacitance is kept to a minimum. (Don't overlook that point if you're trying to play CD-4 records. The 30 kHz carrier frequency may be done in by a relatively high capacitance phonograph cable. If you're using an older model turntable, you may need a replacement cable, as well as a new cartridge.)

If you're thinking about purchasing some semi-pro equipment, it's a good idea to consider the type of connectors used, in addition to the factors just mentioned. Especially on console microphone inputs, it's a great convenience to have Switchcraft three-pin plugs, regardless of what's going on inside the console. Most—if not all—decent microphones use a Switchcraft-type output plug, and professional-quality microphone cables are not only easy to use; they're relatively inexpensive. Be thankful for such small favors, and take full advantage of them.

And as for stereo and quad imaging, and audio schools, more later.
Stones' Rolling Studio

A complete recording studio in a van? For Mick Jagger, it is almost a necessity. Mick and the Stones can be inspired to produce their next hit anytime, but when they're on tour or on vacation, the best recording studios aren't always around the corner. The Stones rely on their Shure-equipped mobile studio for the unmatched recording perfection they insist upon for these moments of midnight inspiration. Whether in a recording session or on stage, the Stones' SM7, SM58, SM82, SM53 and SM56 microphones are their assurance of consistent quality and natural sound.

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Last month we were discussing the
need for, and problems in getting, initi-

ative in the publishing field. This
month brought to my attention a simi-

lar set of questions, in radio, a field

closer to many readers of db. During

the last year or so, a number of NBC

affiliates across the country have been

operating with a format they call the

"news-only" station. In this format, the

network provides updated newscasts

for alternate quarter-hour periods, and

the local station fills in the rest, from

local happenings. For whatever rea-

son, the network decided to discon-

continue this service, so now those sta-

tions are looking for something else
to do to fill in the time formerly oc-

cupied with network program ma-

terial.

PROGRAM ALTERNATIVES

All across the country, stations fill
time, mainly with recorded music that
appeals to the local listeners. Right

now, that is country and western, most

places within miles of where I live.

But when dozens of stations are trans-

mitting the same type of program, and

listeners are limited mostly to people
driving to and from work, most of the

stations eke out a meagre subsistence.

To really get ahead, a station must

show some initiative. Where there is a

larger population within a station's

service area, one station can adopt a

more unique format, such as a talk

show where anyone "out there" can

call in and talk about whatever inter-

ests him. Or they can run interview

shows where interesting personalities

of all kinds are interviewed at regular
times.

SPONSORSHIP DEPENDS ON
LISTENER APPEAL

But whatever format is adopted,

whether the station does essentially

the same as everyone else but tries to
do it better, or whether it does some-

thing different from its neighbors, what

pays the bills is sponsorship. What in-

terests every potential sponsor is how

many people he can reach by means of

whatever advertising medium he uses,

and usually radio is only one of

them.

An argument for the news-only for-
amat, as well as for anything other than

what may be termed background mu-

sic—something to drive by—is that

they are something to which people

consciously listen. So, in an attentive

mood, they will also listen to the spon-
sor's message rather than letting it

go by as part of the background. It

would seem to be a natural for a pro-

gram that grabs listeners' attention to

be something that sponsors would want
to buy.

What a radio station expects will

grab the listeners' attention does not

always do it. When drivers put on the

radio with the idea of providing back-
ground to relieve the boredom of driv-
ing, they do not necessarily want to

have their attention grabbed. How-
ever, if something does grab it, it may

provide a talking point, when they get
to work, or home, or wherever they

are going. And of course, it may also
give them a resolve to listen again, to

hear more of the same, if they like what

they hear.

GETTING INTO EDUCATION

Statistics from other fields, such as

book publishing, i.e., and even theater,
suggest that people want to be more

than just entertained. Non-fiction has

been outselling fiction for some time.

Documentaries are more popular than

they have ever been. So couldn't radio
ger into the business of education,
somehow?

Whatever a station does, it must

find a way to stay in business doing it.

When we mention education, in almost

any context, we soon hear someone
talk about "funding," with perhaps a

reference to "Classroom of the Air." In

most people's minds, education

means something that is tax-supported,

and thus gets away from the "finding

sponsors" hassle. But really, in making

that switch, you merely substitute one

hassle for another, both money. Now

you are looking for funding.

FUNDING PROBLEMS

I do not really want to get into

this, beyond showing what is wrong

with it. As I said, sponsorship de-

pends on listener appeal. Funding
doesn't, at least not in the same way.

So long as what you broadcast ap-

peals to the agency that funds it,

everybody is happy, for a while, at

least. You do not have to please the

listeners anymore.

And that is what really paves the

way for the downfall of whatever edu-
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theory & practice (cont.)

engaged in. So long as the person who benefits from the funding can keep the funding source happy, the money keeps coming. But, sooner or later, something changes, and someone discovers that really nobody is listening to that junk. End of junket.

So let us ask ourselves whether educational programs really have to be funded, or whether we cannot find a way to base their continuance on the establishment of listener interest, like any other format, along with a way to get them paid for on that basis.

Well, one way, perhaps, would be to find sponsors who share your interest in education, and use a commercial format, with whatever educational content you agree upon. One advantage of this is that you can mix it in, part of the time, with some other format instead of changing your whole operation over.

There is another possibility, selling materials to subscribing students, that needs more development, which we will come to later.

RADIO IN A/V INSTRUCTION

What part will your radio program play in the learning process, apart from the obvious one, that to pay by listener acceptance, it must interest them, rather than bugging them?

For the last three or four years, I have been active in producing new kinds of mediated material. The best, from the results viewpoint, is often the most costly. In fact it is often the least costly. Individualized instruction that uses workbooks and exercise books for the visual and student involvement part, with audio cassettes that provide the instruction, have been increasingly successful.

Before we leave mention of that, funded programs using the same media are invariably less successful. When the program designer gets paid for turning something out rather than for producing material that helps people to learn, this difference is really to be expected. If, as some people want us to believe, the profit motive is bad, all I can say is that the non-profit motive is worse!

Back to individualized instruction: the good feature about an audio cassette, with printed workbook and exercise materials, is that each student can take the audio at his own rate. If he comes to something he knows, he can press the "fast forward" button and save himself some time. If he comes to something that gives him difficulties, he can use the rewind button as many times as he needs to.
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Circle 39 on Reader Service Card
theory & practice (cont.)

The audio is best when designed to be repetitive, except with variation, to provide alternative ways of understanding, relying on the student to replay anything he wants to hear twice. We mention this, precisely because that procedure is not adaptable to audio by radio. What should we do then? Redesign the audio for radio?

The more you think about it in those terms, the more difficult it seems. You could be repetitive where the home-use individualized cassette relies on the student replaying material if he needs it. But then you repeat, whether the individual listener needs it or not. You just cannot suit all of the people all of the time.

EDUCATIONAL PROBLEMS

If you think about it, these are precisely the same reasons that more orthodox forms of education are in trouble. Lecturing is not the best way to teach. Yet education consists on gear- ing material on a fixed program basis, so the only variable is the speed at which it is administered.

Schools have been struggling to get results this way, in a losing battle. The four-year colleges have shared the elementary and secondary schools' problems; the only bright spot on the educational horizon in recent years has been so-called vocational education. The junior colleges that offer it have been expanding where the other institutions have been in difficulties.

But at last we are hearing moans from even the vocational ed shops. Why? Because, while they were fresh, they did offer a new approach, different from the boring methods of conventional school. But now they are becoming "establishment" in this sense too.

Come to think of it, most correspondence schools have fallen into the same trap. All of these sources of education work in separate phases: first, they try to sell you a course. On that they do a good selling job, to convince you that you need one of the courses they are offering. Once they get you signed up, their pay is sure.

Public institutions are assured of payment by funding, private, such as correspondence schools, are assured of payment because you sign a contract. So you'll pay, whether or not you take all the lessons. Once they have you signed up, they really do not care whether you learn, whatever their promotion may say.

HOLDING INTEREST

Do you remember the old serial-type story that magazines and periodicals used to publish back in the days before most of their readership was by subscription? That was a circulation-building gimmick. You read this week's, or month's installment. Then it left you hanging at a spot where you just couldn't wait to get the next installment.

Believe it or not, the same thing can be done in education. I know, because I've been on both ends of the situation, taught that way, and teaching that way. And believe me, a teacher who does that does not lose students.

So how can we apply that technique to radio or to some other medium that may offer educational programs?

There are many tricks that can be incorporated. Perhaps tricks is not the word. Really they are techniques. But they work. The cassette audio can probably be used, either as is, or with little modification from the present, good individualized instruction material. The best study, for learning, is what each student does on his own. That is why that method is so successful.

But part of its need for success is competing against all the other things that clamor for the student's interest. This is where the radio can provide, both the first incentive to get started, and the continuing incentive to see "what comes next." The effort should not be to sell the listener a whole course all in one package, either in the learning materials, cassettes and printed work materials, or in a commitment to listen regularly. Get him interested, first, in something that other people are enjoying. Use the radio both to introduce something the listener can "find out" about, for a modest cost, and to provide an aid to continuity in learning. Continuity should not depend on the radio, but the radio should provide information of vital interest when the listener can tune in.

Space is gone, for this month. In later columns, I will discuss in more detail the role that radio can play in supplying this kind of initiative, so that, in return, it can give radio a new lease on life.
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Circle 46 on Reader Service Card
• When I received the December issue of this magazine, I immediately read with great interest the terrific article by Mort Goldberg on tape editing, which brought back many memories, fond ones as well as some of the exact opposite nature. Hopefully, you will permit a small side excursion from the more usual visual material found in this corner.

The last word in Mort’s story on tape editing is also the last word anyone should remember if he or she intends to become a truly professional tape editor—practice—and that should really be written with a capital P. That’s how he gained his well-earned reputation as “the fastest hands in the East” (and for all we knew it could have also included the rest of the country, too). The techniques he discussed are some that he learned and developed to perfection along with a good ear, a precise sense of timing, and a fast pair of hands.

Recollection brought back times when Mort was working on tapes for the news department during innumerable crises, both the world-wide kind and those associated with broadcast time pressures. There were times when the small tape room adjacent to the master news studio was turned into the center for all incoming and outgoing material. One tape machine was recording incoming line and telephone reports while the second was being used for editing previously taped information while the third machine was playing the already taped and edited program to air. The news man in the studio was getting copy ready to broadcast or put down on tape for editing into the program. The phone rang constantly, and the beeper was kept ever on the alert to mix with whatever came in on the phone line. And this was during a normal crisis. When it got really busy.

During conventions, and campaigns, and space shots, and disasters, and elections, and wars (even if they were not officially called that), and whatever else happened which was worthy of reporting, a small team of expert tape editors was used to man the news tape room. Documentary material and delayed programs that were updated for the other time zones were de-fluffed and cleaned up and readied for either broadcast or future use. During slow times in between hectic periods there were some practice sessions, if you can call them that, when the “er” and “ah” sounds taken out of interviews and speeches by the thousands were spliced together in what resembled a long strip of splicing tape on one side. When played back, the tape sounded like a kid with a new toy machine gun.

EQUALIZATION AND FILTERING

Equalization and filtering were very important in many instances. Phone lines are made very cleverly. They have a narrow frequency range around the 3,000 Hz point with some peaking in that area. This is the neighborhood in which the ear is most sensitive. It helps tremendously to use this knowledge when the recorded material is of poor quality. Although equalizing the voice can help clarity, it is also obvious that there is a similar quality change in the background sound. In most cases this may not matter much, but where the edited material has to fit into some other tape, the variation is important. As Mort indicated, a change in the background sound (including quality) is readily detectable, especially since the ears are doing all the work. (When some visuals such as film or even slides are used in conjunction with the sound, it probably matters less.)

One way to cover, or mask, the edit point is to insert one of those “er” or “ah” sounds, or a cough, or a car or fog horn, or a drum beat ... something which is “natural” to the real background. It’s amazing how the ear, or the brain, will accept this interruption and possibly not realize that the background has changed slightly.

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sound with images (cont.)

Some masking is also possible with the continuous loop trick by adding an almost indistinguishable background sound to the whole section of tape.

On several occasions, the technique of "blending" or "mixing" two identical tapes to make an edit came in handy when working on music tapes sent in for broadcasting from N.Y. to the network. Shortening selections by removing a chorus was a neat trick in itself, but there were times when it was necessary to edit a solo quarter note to an eighth note. You might think it would be easy to step up the speed of the note (from 7½ to 15 in/sec., for example), measure the length of the note, cut it in half, then dub back down to normal speed.

On the face of it, this might seem acceptable. It's not, really. First, you must realize that the note has certain artifacts at the impact or start of the note and again at the end. There are also tonal quality changes, depending on the instrument and the natural harmonics. Just cutting out half the note from the center might sound okay to the untrained ear, but it's for the trained professional musician that the edit should really be made if it is to be acceptable to the professional tape editor. Cutting the tape physically can result in an almost imperceptible change in tone, or level, in the note or an almost inaudible "pop." By using the "blending" trick, the tape is kept in motion at the time of the "edit," eliminating the chance of a "pop" and allowing the engineer to adjust correctly for even the minutest level difference.

JOEL TALL

Back in those days there was another member of the tape editing team working with the News Department. In fact, he was the proverbial leader of the team in the sense that he outranked the others in terms of experience and seniority. He worked with scissors like other tape editors at that time and then decided to find a better way. He did. He invented the editing block. His name is on all of them. He called it the EDITall block. His name is Joel Tall. He's considered by many to be the father of audio tape editing. (He fathered the block in about the late '40s.)

A little of what he learned about tape recording, he put into a book that was published more than twenty years ago, and which went out of print less than ten years ago. In this book, some of the material he discussed relates to the characteristics of hearing and how it is possible to take advantage of these to "fool" the ear, or "un-fool" it. (He has been asked several times to be the expert "friend-of-the-court" where tape was involved in a legal case.)

Joe found that aural persistence is about 0.04 seconds, much less than it is for the eyes. He also found that it varies with frequency, being greater at mid-range than at either lower or higher frequencies. Another phenomenon that came up in his work had to do with shocking the ear on hearing a sudden, new, or strange sound.

VERTICAL CUT

When Joe edited tape with a vertical cut, he found that there was a definite click at both the in-cut and the out-cut at 100 Hz. At higher frequencies, the click sound seemed to decrease. At the 45 degree cut he put on his editing block, there was no click. A similar effect is also heard when an editor puts two words unnaturally close together. Actually, it could be shown that there was no click on the tape. It was a sound that the ear seemed to hear, but it could not be edited out by cutting. This had to be recognized before the tape was overcut. The way to eliminate the false sound is to add a bit of space with background sound. Opening the edit with about 1/2 in of tape seems to let the ear "lose" the "click."

Joe has retired from day-to-day work, but he is still active in the audio field. He's working on a new book, and just applied for another patent on a modification to his editing block. The new item will now include a slot at 85 degrees. The 45-degree cut is fine for mono tapes or stereo, but with more than two tracks, a diagonal cut can make an edit on one of the tracks and will ruin the others. The front and back of the cut cannot be apart by more than about 0.03 seconds. At the 90 degree cut, which would be acceptable for sound, there is that "pop," or "click," either due to the magnetic oxide collected at the cut, or to the magnetization of the razor blade, or to the fact that the level of the background recording bias could jump severely from one side of the cut to the other side of the edit.

After extensive travel and discussion with engineers in various countries, Joe figured the 85-degree cut would solve the sound and the "click" problems. At that angle, tracks are cut within acceptable limits, and the bias current is averaged. With the time lag at 15 in./sec. being 0.01 sec. and at 7½ in./sec. being 0.02 sec., the audio tracks are not damaged.

SEPARATE REEL

In his December article, Mort says

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that he puts his out-takes on a separate reel to save for future use. Take this recommendation seriously. It will come in handy for words, coughs, sounds, and background noise. Letting it run off on the floor during editing puts the out-takes under foot. Tape that has been jumbled up and wrinkled just doesn't sound right.

Joe, in his book, makes the recommendation that the tape editor not work under strain of any kind. The sound equipment should be the best, the surroundings as favorable as they can be, for the best editing results. Auditory fatigue can cause a shift in pitch perception, and the missing of short sounds, rendering a good editor incapable of proper judgment and resulting in faulty splices. Sometimes, during news crises, conditions for editing were not optimum, but Joe, and Mort worked wonders—both during long and fatiguing hours. But Joe is right, when it is not necessary to edit under those circumstances—don't!

A few personal random thoughts... Use 1.5 mil tape when there will be editing with a razor blade. The thinner material does not cut well, rolls, and stretches easily so that the sound can become very distorted at the edit points. Use a sharp razor (the single-edged type, please, or you'll get the nickname "Four Fingers"). One way to pick up a little bit of time in the playing time of any material is to wrap a layer or two of splicing tape around the capstan. This trick will not change the speed of the machine, but by making the capstan shaft bigger in diameter will cause the tape to be pulled through a bit faster. There is a limit to capability of this technique; be sure the sticky tape does not catch on the back of the audio tape or you could be in trouble.

If the edit cuts you're about to make seem almost futile or impossible to do, do not use the only copy you have of a one-and-only recording. This is nothing short of dumb if you can't re-fix the original tape. All you will be doing in this foolhardiness is proving the Murphy Law that if something can get loused up—it will! Finally, just remember that the edit block was invented to make editing easier (not for the benefit of the single edge blade industry) but it takes common sense, careful listening, and lots and lots of practice. Good tape editing is something like a good reinforcement system; you shouldn't be able to tell that it's there at all. You should learn not only the tricks of the trade, but the trade itself.

Thanks for letting me recollect a few memories. It sure was a pleasure working with those greats back when...
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*Mfr: Micmix Audio Products, Inc.*
*Price: $1,195.00.*
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*Mfr: Analog Engineering Assoc.*
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Mfr: Acoustilog, Inc.
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Part I of a discussion of script writing. Covers the approach to the client, relationship of the writer to the producer and technicians, and, in a general way, the stages of script presentation from proposal letter to shooting script. Mfr: Motion Picture Laboratories, Inc.
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PLEXIGLAS NOISE SHIELDS

The isolation of disturbing noise through the use of plexiglas acrylic sheets is demonstrated in a 12-page booklet. Mfr: Commercial Plastics & Supply Corp.
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OPTICALLY COUPLED ISOLATORS

An application note describes the use of optically coupled isolators where signals must be transferred from one module to another in the presence of large voltages or induced noise. Mfr: Hewlett-Packard Company.
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RECORDER/REPRODUCER

A leaflet describes the PM-86SL magnetic recorder/reproducer system for motion picture sound. Mfr: RCA.
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Two booklets, "What to Look For Before You Buy an Advanced Calculator" and "The Programming Book" are full of detailed information. Mfr: Hewlett-Packard, Inc.
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LIVE MUSIC

A new monthly newsletter reporting on the live music industry is available free of charge. Mfr: Uni-Sync, Inc.
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KIT CATALOG

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FADERS

Performance data and other information on two new series of linear motion faders and joystick quadripolar potentiometers. Mfr: Penny & Giles Conductive Plastics Ltd.
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- New series 403T, 405T, and 409T loudspeaker/70-volt transformer assemblies are designed for indoor p.a. and music reproduction systems. The 70-volt transformer has a maximum insertion loss of 1.0 dB and primary wattage taps of 0.5, 1, 2, and 4 watts. The compact speakers, which may be flush mounted in any type of wall or ceiling, feature wide distribution angles that enable large areas to be covered with few units.

Mfr: Alec Sound Products
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MOVING COIL CARTRIDGES

- Certain unique features of design are present in this series of moving coil (electro dynamic) cartridges. The stylus cantilever is made of a specially-shaped aluminum alloy, which offers low mass as well as necessary stiffness. A patent is pending on a new damping mechanism as well as a squared pole piece with the shape of the magnetic structure devised to obtain improved linearity of the transducing elements. Models available include: SL 20E, for stereo and 4-channel matrix systems; MC 20, professional stereo and 4-channel unit, supplied with a fine-line stylus; SL 20Q very high quality unit developed for playing discrete 4-channel records. Designed for use with the cartridges, pre-amplifier MCA-76 has a subsonic filter which attenuates sound below 13 Hz and a switchable filter which changes the frequency response to 2-channel or 4-channel mode. A bypass switch makes it possible to bypass the amplifier when using magnetic cartridges.

Mfr: Ortofon (Harman Kardon, Inc.)
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AUDIO DISTRIBUTION AMPLIFIER

- A transformerless bridging input, differential amplifier configuration, is claimed to deliver low distortion and noise from Model 7830 amplifier. The device provides eight balanced 600 ohm outputs, up to +20 dBm level per output with a minimum of 80 dB of isolation between outputs, and from output to input. The amplifier is internally protected against short circuit and input overload. The unit may be rack mounted and contains its own power supply.

Mfr: Modular Audio Products
Price: $330.00.
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AUTOMATED MASTER CONTROL

- Automated computer controlled switching systems, for application in a.m. and/or f.m. radio master control areas provide control of signal routing, tape decks, transmitter, and radio plant supervision, while operating either from a real time program schedule, or sequentially, and logging all events as they occur. All systems in the series utilize one or more Data General Nova computers as the primary control element. Input/output devices provided include keyboard, teletype, and tape cassette. All audio switching is done by balanced solid-state crosspoints which are both transient free and noise immune. Switching by “cut,” “fade-down/fade-up,” and “cross-fade” are possible. Signal loss sensing and automatic fill are also available.

Circle 70 on Reader Service Card
GRAPHIC EQUALIZER

- Feedback suppression, room equalization, sound modification, and special effects are functions of the Model EQ/210 graphic equalizer. The dual-channel, 10-band unit uses no wound coils as inductors. Modified gyrator circuits are employed, with either conventional single-ended or transformerless balanced line for inputs and outputs incorporated. Claimed signal-to-noise ratio is -100 dB. Frequency response is ±1 dB from 20 Hz to 25 kHz.

Mfr: Biamp Systems, Inc.
Price: $229.
Circle 74 on Reader Service Card

RECORDING/LIVE MIXERS

- Application to both recording needs and to live performance is the intent of series 2000 mixers. All four mixers are rack-mountable and have eight modular channels. The integrated systems can be patched in a number of configurations. There are separate monitor controls for each channel. Models 2180 and 2380 are mono; models 2280 and 2480 are stereo.

Mfr: Sunn Musical Equipment Co.
Circle 75 on Reader Service Card

MIXING CONSOLE

- Sixteen balanced and sixteen unbalanced low-Z inputs with four full range outputs are featured on HM 1600 mixing console. The unit also has a stereo two-way 800 Hz 12 dB/octave electronic crossover, low noise outboard power supply, individual input overload led, pan pots, ±20 dB at 50 Hz and 7 kHz. Optional accessories include a four mix submaster module and a phaser module.

Mfr: Heil Sound Systems
Circle 76 on Reader Service Card

TRAVELING MIXER

- Expandable and contractable Trouper II mixer has been designed for road use. It expands up to 38 inputs (8 inputs for the output control module and 10 inputs for each expander module). The unit contains separate monitor and echo send controls, echo receive, preview selector switch for listening to monitor or house outputs in the earphones, headphone jack and level control, phantom power supply for condenser microphone, house and monitor master level controls, vu meter with led peak indicator, high and low frequency eq., led peak indicators and mic pads. Each module weighs less than 30 pounds. A flight case is available.

Mfr: Uni-Sync, Inc.
Price: Output module: $1,500
Input expander module: $1,450.
Circle 77 on Reader Service Card

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www.americanradiohistory.com
TIME MARK GENERATOR

- One main dial calibrates the sweep timing of the oscilloscopes in Model 6130A solid-state time mark generator. The single marker dial sets all 21 ranges from 0.1 μS to 0.5 seconds, paralleling the 1, 2, and 5 sequence found on oscilloscopes. The dial’s time/division setting can be multiplied by either 1, 2, 5, or 10. Marker frequencies are crystal controlled by a 10 MHz precision oscillator whose crystal is housed in a fast warmup, proportionally controlled, solid state oven. The frequency stability of the instrument is 3 ppm in 24 hours at 0.1 μS (10 MHz) after 1.5 hours’ operation (20 degrees to 30 degrees Celsius.) A special high stability ovenized oscillator with drift rates of three parts in 10⁶ per day is optionally available. Applications of the device include calibrating the frequency and time modes of digital counters, the frequency dispersion of spectrum analyzers, and the best frequency calibration operation of signal generators and oscillators.

Mfr: Ballantine Laboratories, Inc.
Price: $845.00.
Circle 61 on Reader Service Card

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PLAYBACK INSPECTION CONSOLE

- All S-8 film formats can be handled by Model 880 super 8 playback inspection console. Checking sound reproduction transfers on S-8 single strand, 16 mm/S-8 (1-3 & 1-4), or quad (5R) film formats at one and two times real time. The system is calibrated against SMPTE super 8 test films for frequency response, signal level, flutter and azimuth alignment prior to shipping. A dual drum, dual sprocket film transport provides a simple film threading path; all tracks are monitored simultaneously on vu meters with switch selectable audio for loudspeaker monitoring. Applications include quality-checking recordings before slitting, and use along with a transfer console or panel printers with sound recording capability.

Mfr: Wide Range Electronics Corp.
Price: $4,650.00.
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AUDI LIMITER

- Precise modulation level control of f.m. transmission systems is offered by Model TFL-280 audio limiter. In addition to f.m. monaural, stereo, quadriphonic, SCA and t.v., audio can be processed by the frequency conscious limiter, particularly emphasizing the solution of problems in the transmission of pre-emphasized audio. The device utilizes existing stereo generating equipment, operated with optimum modulation; a field-removable audio low-pass filter located located prior to the stereo and SCA spectrum. The unit remains in the audio chain for EBS two-tone transmission and proof of performance measurements. Multi-channel AGC interconnection terminals are provided for two or more channel operation.

Mfr: Mostley Associates, Inc.
Circle 62 on Reader Service Card
SOUND LEVEL METER

- Digital and analog displays are both inherent in the Model 1981-B sound-level meter. The device, with a measurement range of 30 to 120 dBa in two switch-selectable 50 dB ranges, meets ANSI S1A and IEC 179 standards. It is possible to hold and display the maximum level measured on the digital display while the analog meter continues to indicate lower levels; either fast or slow detector response may be selected for this measurement.

Mfr: GenRad, Inc.
Circle 64 on Reader Service Card

DIGITAL MULTIMETER

- A convenient touch-hold probe available as an accessory for Model 3465B digital multimeter enables the user to freeze the reading on the led display. The battery/a.c. portable 4½ digit, five-function multimeter has a d.c. measurement range from one microvolt to one kilovolt with a mid-range accuracy of ± (0.2 per cent of reading + 0.01 per cent of range) for one year. The a.c. measurement range is 10 microvolt to 300 volts with a mid-range accuracy of ± (0.15 per cent of reading + 0.05 per cent of range) over a 40 Hz to 20 kHz bandwidth. A.c. and d.c. current measurement range is from 10 nanoamps to two amps. D.c. current accuracy for the 10 mA range is ± (0.1 per cent of reading + 0.01 per cent of range). A.c. current measurements are made over a frequency band of 40 Hz to 20 kHz with a mid-band accuracy of ± (0.25 per cent of reading + 0.25 per cent of range). Open circuit voltage on the ohms terminal, when set to its lowest range, does not exceed 5 volts. The use of a single instead of double reference makes possible a reduction in components, improved stability, and simplified calibration.

Mfr: Hewlett-Packard Co.
Price: $500.00.
Circle 66 on Reader Service Card

TAPE POSITION LOCATOR

- A microprocessor in a compact, self-contained calculator-style case, Selectake II is designed to be used remotely for programming cues. The process involves entering a "store" command and the digitally displayed time on a keyboard. Up to nine separate cues can be stored in the unit's memory; no information is placed on the tape. Cue recall is accomplished by touching the recall key, number key corresponding to the store position, and locate key, which moves the tape drive to the specified location at high speed, stopping within one count of the cue point. The control panel contains the usual control functions—rewind, forward, record, stop, play, and locate. Both digital time and locate readouts cover minutes from 0.00 through 99.99. The display is "frozen" upon tape run out, allowing rethreading without loss of location. High-low switching is automatic; 7½–15 or 15–30 in/sec. ranges can be achieved manually.

Mfr: 3M Company
Price: $1,750.
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Wipe tapes clean in record time.
The Making of the Ampex ATR-100, Part 2

In this concluding segment, the Ampex engineers discuss the four tape speeds, the development of the electronics for superior headroom and phase coherence, timing accuracy for radio broadcasts, and finally future machines to come from this technology.

The roundtable consisted of Robert P. Harshberger, Jr., staff engineer who did the motors and control systems; Alastair M. Heaslett, senior staff engineer whose responsibility included the signal electronics; and Roger R. Sieger, senior engineer who created the mechanical systems (and whose name we misspelled in the picture captions in part one). Also present, and in whose office we sat, was Frank Santucci, the audio product manager for the project and its marketing.

The ATR-100 is a four speed tape machine, but in practice only two speeds at a time can be selected. The other two speeds are available and require circuit board changes to achieve. What I wanted to know was why this method had been selected rather than making it a simple four speed front panel selection alone.

"Mechanically, with the type of servos we are using, four speed operation was easy to implement. However, it must be realized that for every speed you have you must also have a full set of equalizers for both play and record. So, to have a four speed operation from the front panel you would need two more complete sets of equalizers. This, of course, would raise the price significantly.

"It was the considered opinion of both engineering and marketing that few potential users need four speed operation. Rather, most people tend to work at one dominant speed with another as secondary. In the broadcast field the primary speed is 7½ in/sec and sometimes 15 in/sec, with an equal amount at 3¾ in/sec. In the recording field, the dominant speed in Europe is 15 in/sec, and in the U.S. 30 in/sec, with 15 in/sec as a secondary speed.

"All that is required to change to any other speed not already set up is more a jumper on each audio board. For each channel there are two jumpers which select the respective two speeds at which the machine will operate. You only have to reposition those on each channel. Then, of course, you will have to readjust equalization for the speeds you want to use. Incidentally, the machine will only operate at the two speeds selected on the boards. Setting the front panel speed switch to another speed will cause the machine to refuse to function.

"There is no jumpering required for the servos. The audio signal boards control the speed at which the servos will run.

The Electronics Design

My basic question to the group was what was done to the electronic design to get the ATR-100 to be so much better than the 440-C model.

"The short quick answer is that the electronics are designed with margins that accommodate the existing tapes. These tapes may be two or three generations old. The improvements of tape performance over the last five years have been such that these margins have been eroded to the extent that the headroom to electronic saturation above the tape operating level has got to the point where there's not much left anymore.

"In general, however, the ATR-100 improvements have consisted of just attention to detail in each individual element of the signal paths and ensuring that there is enough headroom for today's and tomorrow's tapes.

"Let's put some numbers on headroom. In the reproduce electronics of the ATR-100, the headroom approaches 40 dB and for the record electronics, there is the capability of driving the record head with a signal that is 30-35 dB above operating level (or what we assume as operating level today before any intrinsic internal clipping occurs).

"This headroom is not fully apparent if you take an ATR-100 and drive it to see what happens. Under that condition we would be talking about 20-25 dB of headroom— with modern tapes. That used to be a pretty good number and still is. The 440 had that number when applied to the tapes of its day, but modern tapes have considerably eroded it.

"There are other factors that give the electronics their
present qualities. We've made sure the system is linear from a distortion viewpoint, all the way to the overload point. From a purely design view, that meant circuits with output stages that are symmetrical.

"In short, it was an effort to ensure that there would be enough margin for today's tapes, while adding a bit more to provide for a few more years of tape development.

**PHASE COHERENCE**

Intertrack phase relationships on most multi-track machines are pretty poor. Ampex made a special effort to achieve a high degree of intertrack phase coherence on the ATR-100. I wanted to know how this had been achieved.

"Intertrack phase coherence is affected by many factors. In my notes we talked about the design and construction of the tape heads. With our heads, mechanical gap scatter is so small as to be difficult to measure even with visible light.

"The precision with which the head and the rest of the machine is aligned mechanically is also important.

"Now if a machine is set up without paying attention to these details, you will end up with a system that has intertrack gap scatter. If phase differences were caused by differing track head impedances, you could still do some correction by careful alignment of the heads. This, of course, a mechanical correction for an electrical problem.

"Where the ATR-100 is different from other machines is that a great deal of attention has been given to making sure that the performance of the two channels, or any pair of channels, is as identical as possible to each other. Once these electrical differences are worked out, you are left with the mechanical ones. And these can be readily corrected.

"It is fundamental to the process of magnetic recording that there will be phase non-linearity in the channel. The direct effect of this is that if you put a pulse into the system, and reproduce it, and the apparent amplitude response to the system is flat over any desirable frequency range, the pulse comes out the other end distorted. The form of the distortion is not important, but the fact is that the pulse is not faithfully reproduced. One could ask if the amplitude response is flat, why doesn't the pulse response come flat?

"The answer is because the process has nonlinear phase things happening in it due to the process of magnetic recording. Having said that, now we can go back and say why the ATR is different. There have been attempts in the past on professional machines to put appropriate phase equalization circuits into the electronics with the aim of producing a machine which will reproduce pulses correctly as they are recorded: The drawback to these systems has been that the phase equalization has been accomplished principally during reproducing. The factors which influence the nonlinearity in terms of phase recording are intimately bound up with the particular record head (what was its physical gap length, what was the coating thickness of the tape, how did the user choose to bias the tape?) and a lot of other similar factors. Of course, on that particular machine you could adjust this phase equalizer and indeed come out with a very good replica of a square wave coming off the tape.

"The problem was that the recording that you produced is not compatible in the sense that now you take this recording and play it on another machine which is equalized to reproduce the sine wave response correctly, but it would not possess these good phase characteristics. In a similar sense, if you took a recording that was made on another machine, and play it on this machine which had the phase equalization present, it might help the phase response, but it might make it worse because it just depends on the par-

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**The Ampex ATR-100.**

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**A closeup of the ATR-100 control panel matrix.**
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I had the rare privilege of a short interview with Alexander M. Poniatoff, founder of Ampex, still active in the company although in his eighties. He posed for my camera, seated at his desk.

recording. The nice part of it is that the user is totally unaware of the fact that while he is adjusting his record equalizer to produce a flat amplitude response, he is also adjusting the phase equalization of the system so that the overall phase linearity of the system are considerably better than if the classical kind of record equalizer were used. If you adjust the record amplitude response of the system for a particular type of tape, you produce the correct phase response. By having the phase correction on the record side, the result is a tape that is more phase linear and you can benefit from it on any machine on which it is played.”

TIMING ACCURACY

The ATR-100 is well suited to the needs of broadcast- ing. In this field, timing consistency and accuracy is important, and it was toward this that we talked.

“Let’s look at the worst possible case—a one hour program recorded on one machine and played on another. Under such conditions the total error in one hour would be less than two seconds. More likely, it will be under one second. If, in fact the recording is made today, and played back on the same machine tomorrow, the maximum error will be less than one second.”

ONE AND TWO INCH MACHINES

The present configuration of the ATR-100 is as a quarter- or half-inch only machine. In an attempt to look into the future, I asked about the probability of machines using the new technology for the larger format. The question was fielded by Frank Santucci.

“It must be understood that any larger format is a totally different machine from the ATR-100. The tape handling is different; the control system is different. If we were to start the design today, it would be at least three years before the machine saw the light of production day. Of course, we are looking at one and two inch machines with the performance characteristics of the ATR-100. But there are practical problems. Two inch ferrite heads are a whole new ball game at the very least.

“Of course, Ampex is looking at this project, but it certainly has a long way to go down the pike before it sees production.”

It is easy to become impressed with the product after an interview such as this. But the specifications of the ATR-100 really tell the full story. It’s all the story that has to be told.
A Homebrew Multi-Media Show

Using a couple of your surplus amplifiers, an oscilloscope, and an old t.v. set, you can combine sound with dancing visual patterns.

What must intrigue many experimenters is the notion of how they might utilize the technology they already have available and produce an interesting and sophisticated result with relatively little effort. I was thinking one day of the variety of sophisticated electronic devices I have on hand and how I might interconnect them to produce various results. I have, for example, five television sets, five radios of various bands and types, ten or more amplifiers of various sorts, and four tape recorders. I might add that I do electronic music experimentation and like to connect such things as tape delays through several tape recorders, feedback loops through radio receivers using phone oscillators, and so forth.

My rumination turned to using some of those television receivers for an interesting experiment. Basically, the proposed technique was to use several of those amplifiers I mentioned to control the beam of a large screen television so that sounds would produce the pictures and one could watch his recordings in operation, or whatever else appealed to him.

As there are many ways that this project might be carried out, I will describe the equipment I used and how I did it and others can adapt this to whatever they have on hand. I have a 23-inch General Electric black and white television set with a weak picture tube. The picture is too dim for viewing comfortably. The set has a power transformer power supply. I also have a stereo radio/phonograph with transistor output, balance control, tone control and volume control. The phono input takes ceramic cartridges.

I used the stereo phonograph amplifiers to drive the deflection yoke of the 23-inch television set. Basically, this simply involved disconnecting the speakers from the amplifier, the deflection yoke from its outputs, and connecting the amplifier to the yoke. I used the left channel for vertical deflection and the right amplifier channel for horizontal deflection. Then I connected the stereo amplifier in parallel with the pre-amp output of my sound system.

VOLUME CONTROL

In operation, the volume control on the stereo amplifier controls the size of the display, the balance control determines the percentage of vertical to horizontal deflection, and the tone control handles detail in the display. A signal appearing in the right channel only produces a horizontal line, while one in the left channel produces a vertical line. Separate signals in the two channels produce lissajous patterns while stereo signals of varying phase create rotating patterns of various sorts. These are generally the most interesting of all and make very clear the difference between true stereo and synthetic stereo, which has different material on each channel.

The impedance of a high-fidelity amplifier intended to drive dynamic loudspeakers is close to that needed to drive deflection yokes, which are, after all, simply coils of wire similar to voice coils. Five to ten watts of amplifier power seems to be sufficient for even a 23-inch set; less would be required for smaller sets having less deflection. Although my television set was weak and did not produce sufficient brightness for pictures, I discovered that this was not a serious drawback in the application to sound displays because the beam does not move as fast nor cover so great an area as it does in television applications. The result is apparently greater brightness and contrast.

Z MODULATION

In a normal television picture, the detail is produced against the raster by intensity-modulating the beam of the picture tube. This detail is normally inverted so that no

Robert C. Ehle teaches at the School of Music, University of Northern Colorado, Greeley, Colorado.
Figure 1. Circuit to modify a television set to display lissajous patterns from stereo sound.

signal produces a light screen and the presence of dark elements in the signal drive the tube toward cut-off. This intensity modulation is called Z axis modulation when applied to oscilloscopes and it can be incorporated into the setup described above.

In my own situation, I employed an old Admiral vacuum-tube radio amplifier for Z axis modulation. The advantage of using a vacuum-tube amplifier is that high impedance and a high voltage swing are required and can be easily obtained from such a unit. The output from the amplifier is taken from the primary side of the output transformer through two 0.05 microfarad capacitors to the cathode and chassis of the television set (which should have a transformer in the power supply). If no transformer was included in the set you choose to use, you should add an isolation transformer to eliminate shock hazard.

In using Z-axis modulation, full brightness will be obtained from a display on the left and right channels when the Z-mod channel amplitude is zero. As a signal is inserted on the Z-mod channel it will cause blanking to occur in areas of greatest signal amplitude. The effect of this on a display is to turn normal lissajous patterns into a series of dotted lines. It should be noted that even if you do not connect a Z-modulation circuit, the normal video output circuits may be used and a television signal received from a station may be used to Z-modulate the patterns in a random manner.

MORE EXPENSIVE ADDITIONS

In addition to the circuit described, other variations may be employed. These include using a color t.v. set, use of dot, bar and test pattern generators, use of color dot and bar pattern generators with color sets, employment of projection television systems, causing a pre-recorded video tape recorder to play back special patterns, and use of laser deflection systems. However, most of these ideas require expensive equipment, not generally available in surplus to the experimenter. Still, it is worth considering a few points in connection with a few of the above additions.

USE OF A COLOR TV

Not too many of us have a surplus color t.v. set around just for experimenting but in case you do, there are a few additional things you can add to the system. In the first place, a color set has only one set of deflection coils, so you can only drive one signal to the vertical and one to the horizontal, just as in the case of the monochrome set. The color set has three guns, however, and each one of these may be individually intensity-modulated.

The three guns are deflected together by the coils and focused on a triangle of dots in the three colors on the phosphor screen so, assuming that convergence, purity, etc. have been correctly set up before the sweep circuits were modified, each gun will tend to keep its place in the triangle with the other two. Note, though, that the amount of deflection is a variable, depending on the input signals, so there is no way that each gun can project only on its own color of phosphor. Thus, there is no way to predict which color each gun will energize.

Therefore, the color-patterns will be random. In intensity-modulating each of the three color guns, a separate amplifier is required, just as a single amplifier is used for a monochrome set.

USE OF COLOR AND MONOCHROME PATTERN GENERATORS

These generators have circuitry that generates signals which coordinate with the vertical and horizontal oscillators in a television system. Therefore, once the internal oscillators have been disconnected, there is no way to project the intended patterns. The effect will be random intensity modulation.

PROJECTION SYSTEM

A few expensive projection systems have been built. If one is lucky enough to have a theater with a projection video system for television, this may be used. Most color projection systems are not particularly intense. The most successful projection system for oscilloscopic display is a laser type, using two deflection mirrors attached to loudspeakers, driven from audio sources and a low power laser. Color systems have been built using several different colors of laser beams. Morton Subotnick, the electronic music composer and performer, uses such a laser projection system, along with movies, lights, synthesizers and pre-recorded tapes in his multi-media presentations. The effect is quite spectacular.

SOUND DISPLAY UNIT

To get back to practicalities, I want to describe ways I've used my display system and the effects I've achieved.

First, let me point out that I do electronic music demon-
drations in a rather small room and have often used oscilloscopes so that the audience can watch the waveforms of the sounds as I generate them with a synthesizer. The problem is the typical size of an oscilloscope screen (3-5 inches), but my 23-inch television set provides a satisfactory display. Also, using internal sweep on an oscilloscope means that synchronization is achieved only rarely and that the display is often a confused jumble. With my television display, I have a separate signal from my synthesizer for the left and right channels to the television display and I can actually play the display by selecting sounds from the synthesizer oscillators that produce the most interesting patterns.

I watch the display as I play the synthesizer and work for interesting visual results as well as interesting aural ones. The combination of the two stimuli makes the result much more interesting to the audience, I find, as the two reinforce each other. An interesting visual pattern will attract attention to the sound and vice versa. Playing on such an audio-video synthesizing system is an experience as well—both senses are titillated with effects that are deliberately controlled by the performer. In the usual “light show” such combinations are left to chance because the music or other sound is prepared in advance without consideration of visual effects.

By connecting three different oscillators and other generators to the X, Y and Z channels of the television set, it is possible to generate some very spectacular animated displays. It seems that low-frequency oscillators create this sense of animation best. They may be mixed with higher frequencies, or, better yet, frequency-modulate higher frequency oscillators so that the result is a switching of patterns at fixed rates. Such circuits as voltage-controlled oscillators, ring modulators and electronic metronomes may be used to advantage to create interesting patterns and motion. Anyone having a synthesizer will find that such a display adds a considerable new dimension to its enjoyment.

WATCHING RECORDS
It may make a good joke, but with such a system you can tell your friends that you are going home to “watch a few sides”! Seriously, many records produce spectacular visual results and you may find yourself going through your record collection to see what sorts of effects you can discover. As pointed out earlier, changing phase relationships between the channels cause patterns to rotate on the screen at the speed of the phase shift. Also, since the ear responds to the logarithm of the amplitude (the decibel scale) in its perception of loudness, while the video display responds to the amplitude directly (in the form of voltage), a very small change in loudness can produce a large change in the size of the display. The display can be a very vivid replica of the sound as a result, calling attention to the smallest details.

Since one channel produces vertical deflection and the other channel, horizontal, a combination of two channels carrying the same signal, in phase, produces one diagonal and, out of phase, the opposite diagonal. Thus the device serves as a good indicator of channel separation. It would be possible with some differential amplifiers and a resistor matrix to convert the display to a four-channel display of the sort employed in some audio equipment. It would also be possible to display matrix quad records to see the in-phase information and out-of-phase information. But that’s another project, beyond my intentions at this time.

---

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Sheet Lead Insulation in Recording Studios

Consideration of lead sheets for noise insulation includes a hard look at extra cost as well as the efficiency of the material.

In discussions concerning the sound proofing of a partition between two adjacent rock recording studios intended to be employed for simultaneous recording sessions, the use of sheet lead is almost always mentioned. It seems to carry a magic connotation, as if the material had sound insulating qualities far above the more common building products, assuring excellence in sound insulation. It is the purpose of the following to examine the advantages and disadvantages of sheet lead for the sound attenuation of barriers.

**ACOUSTIC MASS LAW**

To break the "spell" of lead immediately, it may be said that at 500 hertz it is no better than any other product of equal surface density, that is, mass per square foot. This may be quantitatively conveyed by stating the acoustic mass law:

\[
Tl_{500} = 23 + 14.5 \log M
\]

where \( Tl_{500} \) = sound transmission loss of a homogeneous barrier

\[ M = \text{surface density of barrier, lbs./sq. ft.} \]

\[ M^1 = \text{surface density of barrier, kg/m}^2 \]

The above equation pertains to random sound incidence, and was derived empirically. It agrees well with theory, except for the fact that it does not quite provide an increase of 6 dB for double the surface density, but one of only 4.5 dB. Except for the low- and high-frequency resonances associated with such panels, the sound transmission loss between these resonances increases 6 decibels per octave above 500 hertz and decreases a similar amount per octave below 500 hertz.

One advantage of lead lies in the fact that its coincidence frequency is higher than that of any other building material with the same surface density. This latter condition of equal mass per unit area must always be considered in such comparison evaluations, because, as shown above, near 500 hertz, materials of equal surface density offer the same amount of sound attenuation. Wave coincidence occurs when the wavelength of the bending wave in the panel equals that of the incident sound in air; this causes the amplitude of the transmitted signal on the far side of the barrier to be almost equal to that on the source side. The frequency at which wave coincidence occurs in a simple partition is given by

\[
f_c = \frac{2 \times 10^6}{d} \sqrt{\frac{D}{E}}
\]

where \( D \) = density of panel material, kg/m\(^2\)

\( E \) = modulus of elasticity, kg/m\(^2\)

\( d \) = thickness of panel, cm

**PANEL THICKNESS**

The table below gives the panel thickness in both centimeters and inches of various building materials which have the equal surface density of 48.82 kg/m\(^2\) (10 lbs./sq. ft.).

<table>
<thead>
<tr>
<th>Material</th>
<th>cm(^d)</th>
<th>inch</th>
<th>D/E</th>
<th>( f_c ) (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>0.431</td>
<td>0.17</td>
<td>6.65\times10(^-4)</td>
<td>12,000</td>
</tr>
<tr>
<td>Plywood</td>
<td>3.180</td>
<td>1.25</td>
<td>0.5\times10(^-4)</td>
<td>422</td>
</tr>
<tr>
<td>Concrete</td>
<td>2.12</td>
<td>0.833</td>
<td>1.04\times10(^-4)</td>
<td>1000</td>
</tr>
</tbody>
</table>

The surface density of 10 lbs./sq. ft. in the above table was chosen because it conforms well with the surface density of one wall of a double-stud partition separated several inches from the other, as is often the construction of a partition between two recording studios.

Figure 1 shows the sound transmission loss characteristics of the three materials listed in the above table when they have the same surface density. It is seen that the 0.431 cm (0.17 in.) thick sheet lead is really a far better sound insulator above 5,000 hertz than required. The TL at this frequency for one stud wall is 57.5 dB, whereas at 125 hertz it is only 27 dB, the same as it is at the other materials. But it is exactly at the low frequencies where most recording studios' partitions are insulation-deficient, since the sound pressure levels of low musical notes is generally much greater than in those of the treble range.

The high coincidence frequency on the part of lead exists for all thicknesses of sheets as long as they are compared with other building materials having equal surface density. It is only by going to thicker sheets of lead (thicker than the 0.17 in. considered in the table) that this frequency can be lowered. Thus, by employing a 0.34 in. thick lead panel, weighing 20 lbs./sq. ft. the frequency can be halved to 6,000 hertz. Obviously by employing a sheet of lead thinner than 0.17 in., the frequency will be raised, as is evident from the equation for the coincidence frequency.

Michael Rettinger, a frequent contributor to db, is an acoustical consultant from Encino, California.
One advantage of lead is that it can readily take curvilinear shapes, because it is so soft, unlike plasterboard and plywood.

One decided disadvantage of lead is its cost when compared to other materials of equal surface density. Thus, presently, (1976), the price of sheet lead is 40¢/lb. Since ½ in. plasterboard, weighing 2 lbs/sq. ft. costs 85¢/sq. ft., it is seen that lead sheets comparable in sound insulation to plasterboard cost ten times as much.

PARTITION THINNESS

To overcome the structural weakness of sheet lead, and to take advantage of its high surface density to achieve a thin partition when the resulting increased floor space provides a return on the money, the material is advantageously employed in laminate form, whereby it is sandwiched between two sheets of plasterboard, plywood, Transite, etc.

We see, therefore, that the chief advantage of sheet lead in recording studios lies in the relative thinness of the partition required to achieve a desired sound transmission loss over most of the common audio frequency range, compared to other building materials of equal surface density. Its chief disadvantage lies in the high material cost per pound, compared to that of other building products of equal weight. This disadvantage can only be compensated for by the extra floor space resulting from the thinner partition—actually by the greater monetary return gained from the extra floor space. In the case of a 30 ft. long partition between two recording studios, where the sheet lead partition results in a 4 in. thinner partition (2 in. thinner measured from the center line of the partition) the extra floor space in each studio comes to 30×2/12 = 5 square feet, representing possibly the floor space for one additional instrument in each studio.

Assume now that the above partition is 20 ft. high and is to have a surface density of 20 lbs./sq. ft. With sheet lead priced at 40¢/lb., the lead partition material will cost 30×20×20×4 = $4,800, compared to the cost of an equally heavy plasterboard partition of $960. Will the extra 10 square feet of floor area gained by the thinner lead partition return $4,800 - $960 = $3,840 within a few years?

The decision whether or not to use lead must incorporate the cost return on the gained space as well as lead's noise insulation capacity in relation to cheaper, but bulkier materials.

---

Figure 1. Sound transmission loss characteristics of plywood, concrete, and lead.
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EXPERIENCED MUSIC MIXER For major N.Y.C. studio, expanding staff. Send resume to Dept. 72, db Magazine, 1120 Old Country Rd., Plainview, NY 11803.
Announcement has been made of the election of John E. Hammel to the newly created position of assistant vice president, investor relations of the General Telephone & Electronics Corporation, of Stamford, Conn. Mr. Hammel has been with GTE since 1953, at which time he joined GTE's Sylvania, Inc. in an accounting capacity.

Stepping up from the post of vice president of marketing/sales, Larry Lynn has been named as president of the Sunn Musical Equipment Company, of Tualatin, Oregon, a subsidiary of the Hartzell Corporation. Mr. Lynn will be responsible for the Sunn Musical Equipment group, including Sunn/Magna Professional Audio Products.

Promotion to the post of national sales manager for Hal Loman has been announced by Superscope, Inc. of Chatsworth, Ca. Mr. Loman moves up from the position of vice president of Superscope Chicago, the firm's midwest subsidiary.

A second manufacturing facility, occupying about 26,000 square feet and costing $4 million, is being constructed by the Sony Corporation in Dothan, Alabama. The new plant manufacturing shells for the Betamax videocassette, is scheduled to be completed in October, 1977.

Plant III, a new building which houses the main offices of the Studer-Revox organization, as well as their research and development, data processing and production facilities, has been opened at Regensdorf, Switzerland. The address is CH-8105 Regensdorf, Switzerland, Althardstrasse 30.

Replacing George DeRado, Masaji Takahashi has assumed the position of president of TEAC Corporation of America. Mr. Takahashi had been executive vice president of TEAC Japan. Mr. DeRado, who is chairman of the board of Damark Industries, will maintain his connection with TEAC while concentrating on his duties at Damark.

A 24-track studio has been opened in New York City by Sigma Sound, of Philadelphia. The facility contains a 25 x 40 foot studio with a 65 square foot glass isolation booth, a 17 x 20 control room and a listening lounge. The address is at 1697 Broadway.

Two new sales engineers have been added to the staff at Martin Audio Video Corporation, of New York City. Courtney Spencer has a background of writing music and producing radio and t.v. commercials. Tony Hawkins comes from England, and has been associated with the Revox Corp.

International Rectifier has opened a new facility at 348 Kansas St., El Segundo, Ca. to produce solar energy cells, photocell arrays for digital punched card and tape sensors, as well as silicon photocells for photometer and other sensing equipment. Gerhard Fischer has been appointed manager of the opto-electronics activity.

Russ Ide has been appointed Rocky Mountains area sales engineer for the audio-video systems division of the Ampex Corporation, of Redwood City, Ca. Mr. Ide will cover the territory of Arizona, Colorado, Montana, New Mexico, Utah, Wyoming, and southern Idaho from the firm's Salt Lake City headquarters. He comes to Ampex from TeleMation, Inc.

Jensen Tools of Phoenix, Arizona has named Dave Hackenbruch as national accounts manager. Mr. Hackenbruch's particular bailiwick will be consulting with firms requiring special or custom-designed tool kits.

Studio attenuator and open-frame rotary switch product lines recently acquired from the McGraw-Edison Company, are being manufactured by Shalco, Inc. at their Smithfield, N.C. plant under the supervision of Mike Sutton. The products, which have been sold under the Daven name, retain the same part numbers and designs.

Four telephone pioneers, John A. Balch, Carl D. Broeini, Sr., Chester H. Loveland, and Talbot G. Martin, have been elected to the Independent Telephone Hall of Fame, a museum in Washington, D.C. Mr. Balch was active in the telephone's development in Hawaii. Mr. Broeini, starting his career in Florida, was a director of General Telephone & Electronics, New Yorker Chester Loveland was instrumental in purchasing utilities companies, which merged with General Telephone & Electronics. Inventor Talbot G. Martin installed the first private automatic telephone system in the White House for President McKinley in 1898. He was responsible for much of the research and development progress of the independent telephone industry.

Details are being finalized for the acquisition of Switchcraft, Inc. of Chicago by the Raytheon Company, of Lexington, Mass. Switchcraft will continue with its present management and other personnel and plant facilities in Chicago and Paxton, Ill. Wilfred L. Larson will continue as president. Fred Dumke as secretary-treasurer, and William Dumke as vice president for manufacturing and engineering.

The new post of assistant sales manager at Otari, of San Carlos, Ca., has been filled by Lewis Barrett, coming from Sound Genesis. Mr. Barrett will service dealers and distributors of the firm's professional recorders and duplicators.

Of interest to educators and others who buy audio-visual materials and equipment is a publication compiled by the National Audio Visual Association entitled THE A-V CONNECTION: THE GUIDE TO FEDERAL FUNDS FOR AUDIO-VISUAL PROGRAMS. Selling for $15.00, the books are available from NAVSA, 3150 Spring St., Fairfax, Va. 22030.

A new 500 oersted video tape will be one of the products in the bailiwick of Mike Skelton, new product manager at the Memorex Corp. of Santa Clara, Ca. Mr. Skelton was previously based in the Great Lakes area.
And the rave reviews go on and on. "At last...a decent book on microphones," said David Lane Josephson in Audio. "Excellent chapters on various aspects of microphones, which are discussed in great detail," said Werner Freitag in The Journal of the AES.

They’re applauding Microphones: Design and Application, by Lou Burroughs, who has written this practical, non-theoretical reference manual for everyone involved in the application of microphones for TV, motion pictures, recording and sound reinforcement.

Twenty-six fact-packed chapters cover the field of microphones from physical limitations, electro-acoustic limitations, maintenance and evaluation to applications, accessories and associated equipment. Each chapter is crammed with experience-tested, detailed information, and clear, precise diagrams and illustrations that complement the text.

Along with down-to-earth advice on trouble-free microphone applications, Lou Burroughs unfolds dozens of invaluable secrets learned during his more than three decades of achievement in the field. He solves the practical problems you meet in everyday situations, such as:

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