

SYNERGETIC
SYN AUD
CON
 AUDIO CONCEPTS

newsletter

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SYNERGETIC

Working together; co-operating, co-operative

SYNERGISM

Co-operative action of discrete agencies such that the total effect is greater than the sum of the two effects taken independently.

EXCHANGE OF IDEAS

I met a man with a dollar	I met a man with an idea
We exchanged dollars	We exchanged ideas
I still had a dollar	Now we each had two ideas

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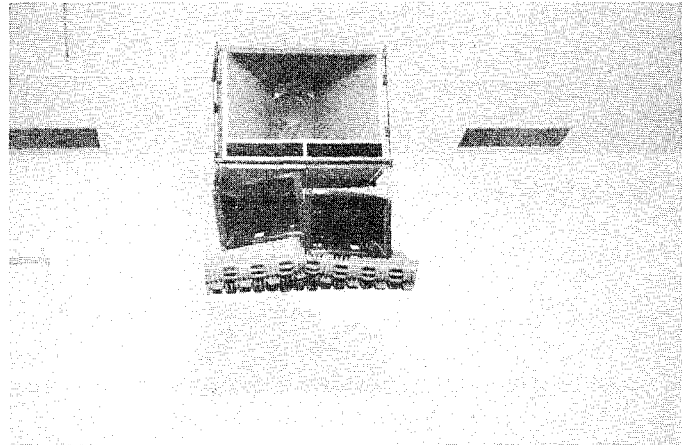
MAY 1980 AES CONVENTION

The May 1980 AES Convention saw many Syn-Aud-Con graduates, sponsors, and associates engaged in sharing their experiences with the audio industry as a whole. Carolyn was the convention chairman (she refused the title "chairperson" on the basis that she isn't neutered).

GLEN BALLOU was the Papers Chairman (as he is for November 1980 AES Convention in New York) and the high quality of papers presented spoke well of his disciplined, devoted approach to his chairmanship. Session Chairmen included Mahlon Burkhard of Industrial Research Products (A Syn-Aud-Con sponsor); GERALD STANLEY and DAVE McLAUGHLIN of Crown International (Syn-Aud-Con sponsor); TED UZZLE, a many times Syn-Aud-Con graduate and frequent contributor to the Newsletters; James Moir who helped conduct the first Syn-Aud-Con graduate seminar in 1978; JOE MARTINSON, an active TEF™ practitioner; CHIPS DAVIS, builder of the first LEDE™ control room; VIC HALL, many time Syn-Aud-Con graduate and staunch Syn-Aud-Con supporter; MANNY MOHAGERI of Emilar fame; and MARY GRUSZKA, a Syn-Aud-Con graduate (more about Mary below).

The official sound system for this AES convention was provided by The Rauland Corp and RICK BLUNT assembled a truly professional collection of equipment and Rauland personnel to operate it.

The Rauland loudspeaker array (one of two with digital time delay bringing them into a useful relationship) used at the May AES Convention is shown here. Note the pad of Sonex foam placed under the array in an effort to deflect the bottom lobe.



LARRY ESTRIN enjoyed his work as Banquet Chairman enough that he was willing to take on the post of Convention Chairman for the next AES Convention in Los Angeles.

There were 23 Syn-Aud-Con graduates involved in giving papers. There were a lot of good papers and there were some really outstanding ones. Dr. Diamond, C.A. Puddie Rodgers and Dave Andrews papers will become part of the literature. Dr. Diamond and Tom Osborne's papers were not preprinted so one had to be there to hear them. We were proud of the papers by Syn-Aud-Con graduates: Puddie Rodgers on Localization; Dave Andrews on the PZM™, Ed Long on PRP, Carl Adkins on the SBA system; Richard Jamieson, Ed Bannon, Milton Putnam, Phil Salisbury, Ted Uzzle, Ralph Gibson, Clay Barclay, Garry Margolis, Sam Bridges, Dave Moore, Nyaa Lark, Chips Davis and Mary Gruszka.

Women in Audio

This was a historic and very successful first time session. The chairman was Mary Gruszka of CBS TV network and she gathered together an exceptional panel of proven audio talent to represent the role of women in audio. Panel members of this First in Audio were:

Pamela Peterson
Margaret Finn
Jennifer Mathes

NYAA LARK
PUDDIE RODGERS

The session was standing room only and the overflow was covered by closed circuit television in an adjoining room.

Mary talking with Don during the May 15 class. Mary was the first woman Syn-Aud-Con graduate.



Ted Uzzle

Ted Uzzle put together the session with the most excitement: Motion Picture Technology held on location at the Academy Goldwyn Theater. Ted wrote us from Boston about a conversation he had about the convention

I attended the annual banquet of the Boston section of the AES. As we were waiting for the elevators down afterward (it was at the Faculty Club at MIT) we got to talking to Dick Burwen and his wife about the convention. We spoke of Dr. Diamond, and the reaction to him, and Walter Murch, and such. Elevators came and went, but we stood there and laughed and told stories. Finally Mrs. Burwen turned to her husband and declared, "You drag me to all those boring conventions, and then we miss this one."

As usual Ted Uzzle tells it as it is. Carolyn has left a real mark for future chairmen to reach for. It isn't often that the AES gets a chairman as thoroughly in touch with our audio industry.

DR DIAMOND'S DIGITAL DELTOID DEMONSTRATION

The West Coast AES Convention in May featured a paper by Dr. John Diamond, a behavioral kinesiologist, on "Human Stress Provoked by Digitalized Recordings".

This provocative title resulted in a packed, standing in the aisles, no further admission allowed session.

Dr. Diamond's thesis was a simple one. In his work as a "holistic" psychiatrist he has used recorded music as therapy with disturbed patients. Recent re-recordings of musical material he has used for years suddenly began to produce opposite results from those obtained formerly.

The cause, according to Dr. Diamond, lay in the re-recordings having been processed by digital equipment and the earlier recordings were analogue. Dr. Diamond's concern is that in re-recording our historical recordings, "all of our present day musical heritage will be recorded in a form that will be stressful to all listeners, both today and in the future".

Dr. Diamond proceeded to demonstrate the effect described by first playing analog recordings and testing the deltoid muscle. (The deltoid muscle is a commonly used "indicator" muscle which is tested by pushing down on the outstretched arm of the subject. The motion is not an overpowering one, but only the force necessary to ascertain if the muscle locks in place.

The demonstration was dramatic, to say the least. Not one volunteer (there were a number of Syn-Aud-Con graduates who report that so far as they are concerned, no apparent trick was being played on them) was able to keep the muscle locked during the digital recordings playback, but were easily able to do so during the analogue playback of *exactly* the same music.



This, according to Dr. Diamond, is proof of the *stress* produced by digital recording processes.

Reaction of the Audience

A majority of the audience, let us say at once, viewed the demonstration with surprised interest. A small group felt it necessary to attempt to immediately and vocally discredit Dr. Diamond's demonstration. A number of this group were discourteous and out of order. Their general approach was, "We are scientists - suppress this demonstration", or other words to that effect. The majority responded by telling them to shut up, sit down, and allow the demonstration to be made. Certainly the "mental deltoid" of some commentators seemed to have been weakened.

As is often the case, TED UZZLE's remarks made to us in a letter after his attendance at the session comes directly, relevantly, and energetically to the point.

At AES I was fascinated by Dr. Diamond's presentation until I realized that was all he had; one demonstration over and over. I hope someone completely neutral or mildly sympathetic to John Diamond will find or conduct a rigorously structured, double-blind test of his thesis.

Why? Because those concerns with major financial commitments to digital processing of audio are certain to conduct rigorously structured, double-blind tests to try to duplicate his thesis. If they

fail, November AES will be loaded with papers blowing him out of the water. If they succeed, we'll just never hear of their tests, and when asked, digital outfits will simply reply, "He never proved it." And, of course, they'll be correct.

In my opinion, Dr Diamond's concepts are too exciting and too important to be left to his enemies to prove or disprove in the rigorous, scientific way he refused to undertake.

A publishable, compelling paper could be put together by a talented graduate student in psychoacoustics in about six weeks, with a prestigious review board and about a dozen (poorly) paid volunteers. The thing could be done for under a thousand dollars. The pity is Dr. Diamond didn't do it; the tragedy would be if nobody did it; the holocaust would be if Dr Diamond's opponents did it, proved him right, and then suppressed the results.

Ted sent us an entertaining account of "Clever" Hans the stallion who could answer questions put to him by tapping his hoof. It was found later that "Clever" Hans responded to clues such as the anticipatory tilting of the head by the questioner as the correct number of taps was approached. Even the trainer was unaware of these subliminal clues. The moral reached is, "Two creatures who seem to be communicating with each other may simply be responding to each other's non-verbal cues".

The Nature of the Response

The direction and magnitude of the response of those labeling themselves scientists or intellectuals and wishing to deny Dr Diamond his chance to put forth his viewpoint brought vividly to mind the passage from John Toland's biography, Adolf Hitler where he discusses the mass extermination of human beings by the Nazis.

To supervise this mass killing, Heydrich and Himmler had been inspired to select officers who, for the most part, were professional men....The majority were intellectuals in their early thirties and it might be supposed such men were unsuited for this work. On the contrary, they brought to the brutal task their considerable skills and training and became, despite qualms, efficient executioners.

Which brings us to the reason for writing these comments. While it has been our experience that a great deal of what we are asked to accept as "self-evident" or "on faith" turns out to be foolishness, it has also been our experience that utter reliance on the left half of the brain alone leads to a sterile, depressive end result. Thus we have come to view that which is new and different with reserved judgment (so long as it is harmless to us and to others also, and to allow time and subsequent events to either further accept or deny the idea presented.

The Role of Consciousness

We are all aware of the role of consciousness in our perception of what we in our arrogance call reality. Certain influences can and do strengthen and other weaken the human spirit. Therefore Dr Diamond's attempted extension of the work of Dr. George Goodheart, who in 1964 "demonstrated the interrelationships of muscles to internal body function utilizing standardized muscle tests previously developed for medical diagnosis" should receive the careful analysis Ted Uzzle suggests. More importantly, Syn-Aud-Con graduates should re-examine what is meant by the "scientific approach" and recognize that while the materialists would limit it to their prejudgments, it has far wider application.

Dr Diamond visited Syn-Aud-Con Suite



Following Dr Diamond's AES paper, he came to our suite for a couple of hours. Dr Diamond makes some interesting demonstrations using digital watches (held on the pulse side of the left wrist), passages in writings where the author didn't know what they were talking about, and merely having the subject think of an unpleasant topic -- all these stimuli caused a "weakening" of the deltoid muscle in the demonstrations we witnessed.

We'd be interested in any and all input you'd like to contribute and the best work will be published by us in the upcoming Newsletters.

Legitimate questions we have are:

1. Is behavioral kinesiology a widely accepted medical fact, specifically the use of the deltoid muscle for "stress testing"?
2. What has been your experience with digital recordings?
3. What ideas do you have for testing Dr Diamond's thesis?
4. If digital recordings cause stress, is that good or bad?
5. Is behavioral kinesiology the world's most sensitive distortion detector?

You can easily follow what fun was had by all when Dr Diamond touched their thought.

PUDDIE RODGERS writes:

...I do think that an experiment should be run with strict controls to quiet the masses. However, I don't believe that it is a psychoacoustic experiment. I really believe that someone who is versed in kinesthetics needs to run such an experiment. I personally believe that it has to do with the amount of high energy, low frequency information which is encoded on digitally mastered (recorded) albums and is not on the analog ones. There is a great deal of research which shows that high intensity, low frequency sounds weaken muscle tone. Is this stress or relaxation? Good or bad? I for one love the digital bass.

A final word for the skeptics. You have every right to be one. If Dr Diamond is proven wrong, however, that still proves only that you were a skeptic, not that you were right about anything. From the skeptics we seek creative criticism of this thesis - not attacks on Dr. Diamond, protestations of your scientific integrity or other non-relevant reactions. What can you demonstrate to prove he is wrong?

If, and we emphasize the *if*, Dr Diamond's thesis, or any part of it, turns out to be worthwhile, how fascinating it will be to seek out via this test the truly strengthening experiences in our audio world. So far we have witnessed the following effects cause weakening of the deltoid muscle.

Dr. Diamond continued

1. Digital recordings
2. Digital wristwatches
3. Sugar under the tongue
4. Smoke blown in the face of a non-smoker
5. Digital telephone conversation
6. Unpleasant thoughts

We also observed that those least likely to be affected by these stimuli have a very high energy level. KEN WAHRENBROCK is affected by the digital telephone and smoke in his face only.

Research

We are hopeful that the AES will expend some of the money it has on hand for "educational purposes" to fund the research called for by Dr Diamond's demonstration. We *know* that members of the digital industry are funding research, but I go back to Ted Uzzle's earlier remarks. RUSS BERGER from Dallas called to say that he has interested SMU in a research project. I'm sure there are other projects going on. AES in New York this Fall is going to be fun.

Special Thanks

JOE MARTINSON was the chairman for the technical session where Dr Diamond's paper was given. Joe attempted to involve the digital recording companies in the paper by having them submit special recorded material and tape machines. Perhaps understandably they refused. Perhaps just as well to wait until November AES.

References

- "Your Body Doesn't Lie", by John Diamond.MD, Warner Books (paperback) 1979. Available by writing Institute of Behavioral Kinesiology, P O Drawer 37, Valley Cottage, New York 10989 if your bookstore doesn't have it. \$3.50
- "Holistic Dental Horizon" Vol 2, no 8, May 1980. Available through Howard H. Bleicher DDS, 4731 Laurel Canyon Blvd, North Hollywood, CA 91607. (Juergen Wahl of UREI sent us his copy of this interesting publication)
- "Adolf Hitler" by John Toland, Ballantine (paperback) 1976. A fascinating book by any standard
- Personal Communication, Ted Uzzle, May 19, 1980
- Personal Communication, Puddie Rodgers, June 10, 1980
- "Conference", The New Yorker, (56:14) May 26, 1980 pp 28-30

SPECTRAL CONSIDERATIONS ... by C. A. RODGERS

C.A. (PUDDIE) RODGERS of Rauland's engineering department and a doctoral candidate at Northwestern University in Evanston, IL presented an outstanding paper at the May 1980 AES Convention, entitled, *Spectral Considerations - The Implications of Recent Theories of Localization on Sound Reproduction.*

We cannot discuss Puddie's paper in detail as she wishes it withheld from publication until a further revised version is printed in the AES Journal.

She demonstrated with elegance the role of the human pinna as a generator of comb filters. (The role of the pinna is to assist the hearing mechanism determine direction of arrival of sounds.) Puddie then demonstrated the similarity of these pinna generated comb filters, which vary with azimuth and elevation, to comb filters generated by misaligned loudspeakers, early reflections, etc., and how they are then detected by the human listener as directional clues.



Puddie Rodgers is uniquely equipped to make these observations as she has been working with the TDS equipment at Rauland. (She is shown here with Dick Heyser during the November TDS-Heyser class.)

She observed that the pinna varies with each individual and that a "misaligned" pinna determined by the shape of the pinna, can cause a person to incorrectly localize. He cannot train himself to correct for the mis-alignment. Therefore, when someone has a misaligned pinna, his mix will reflect the problem. If someone tells you that the stereo imaging is bad on your music system or in your control room, ask him if he's had his pinna checked. (The ultimate in one-up-manship.)

Our judgment is that when the AES comes around one day to doing an anthology of psychoacoustic papers, Puddie Rodgers' paper will be considered one of the great ones.

TIME-DISTANCE DISPLACEMENT

A majority of the psychoacoustic texts have difficulty with this question. C. A. (PUDDIE) RODGERS, of Rauland's Engineering Department, brought to our attention some extremely important work done by Hebrauk, Wright and Wilson at Duke University in the 1970's.

"They used noise added to a delay of itself and presented monaurally as their test stimuli. They found that on A/B tests, differences in delays on the order of 7 usescs could be detected."

The subject's detection of these minute time differences proceeded from the spectral changes they caused and were not detected as time intervals as such.

What does it all mean? One thing it means is that misalignment of two full range sources by as little as

$$\frac{x \text{ ft}}{.000007 \text{ secs}} = \frac{1130 \text{ ft}}{1 \text{ sec}}$$

$$x \text{ ft} = .000007(1130)$$

$$x'' = .000007(1130)(12) = .095''$$

Ninety five one thousandths of an inch.

A new school of excuses is developing in which time smear is to be considered desirable as it gives you something (a second thing) for seemingly nothing. How many times this type of thinking seems to surface on the audio horizon like some kind of Loch Ness monster. Actually, it's usually locked mental bowels and they can observe or ignore good basic work for many years before being overcome.



Chips Davis and Puddie Rodgers during the November Heyser-TDS class

HP 41 GAIN & LOSS PROGRAM

Syn-Aud-Con Tech Topic Volume 7, No. 3 (Fall 1979) entitled "Electrical Gain and Loss from Voltage and Impedance Measurements" can be easily made into an H.P. 41C program. The input level available power is added by subtracting the "Gain" from the output power in dBm. (i.e., 14.95 dBm - 12.6 dB = 2.35 dBm)

<pre> XEQ "GAIN" INPUT R=? 10.000.00 RUN SOURCE R=? 150.00 RUN LOAD R=? 8.00 RUN INPUT V=? 1.00 RUN OUTPUT V=? .50 RUN dB GAIN=12.60 SOURCE V=1.02 dBm OUT=14.95 </pre>	Input Data	<pre> PRP "GAIN" 01+LBL "GAIN" 02 "INPUT R=?" 03 PROMPT 04 STO 01 05 "SOURCE R=?" 06 PROMPT 07 STO 02 08 "LOAD R=?" 09 PROMPT 10 STO 03 11 "INPUT V=?" 12 PROMPT 13 STO 04 14 "OUTPUT V=?" 15 PROMPT 16 STO 05 17 RCL 05 18 X12 19 .001 20 RCL 03 21 * 22 / 23 LOG 24 10 25 * 26 STO 06 27 RCL 04 28 RCL 02 29 RCL 01 30 + 31 RCL 01 32 / 33 * 34 STO 07 35 X12 36 .001 37 / 38 RCL 02 39 / 40 LOG 41 10 42 * 43 6.02 44 - 45 STO 08 46 RCL 06 47 X10Y 48 - 49 STO 09 50 "dB GAIN=" 51 ARCL X 52 AVIEW 53 STOP 54 RCL 07 55 "SOURCE V=" 56 ARCL X 57 AVIEW 58 STOP 59 RCL 06 60 "dBm OUT=" 61 ARCL X 62 AVIEW 63 END </pre>	<pre> Output dBm Coupling Factor True Source V </pre>	<pre> Available Input pwr </pre>
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SAYINGS THAT PAINT PICTURES

"I've never been poor, only broke. Being poor is a frame of mind, being broke is a temporary condition." MIKE TODD

Egotism is the anesthetic that dulls the pain of stupidity." FRANK LEAHY

GERALD WILLIAMS sent the above in from an inspirational magazine. We could add:

"It's better to be stolen from than to have to steal." From the movie *The Red Shoes*

and "The good man's heaven would be a hell to the sinner." MARY BAKER EDDY

TOM OSBORNE

Another "guilt by association" photograph that gives me great pleasure to publish. We all know the audio enthusiast on the left. On the right is GERALD STANLEY of Crown International. Gerald is the designer of the Crown DC300 and is the drive behind Crown's TEF™ dedicated instrument due out early in 1981.

The man in the middle has affected all of our lives in a remarkable manner. He is Tom Osborne, the designer of the H.P. 35 calculator and the man responsible for its using reverse polish RPN.

I'll never forget my first computer-calculator. It was an H.P. 9100A and Tom Osborne designed it also. Lacking a 10^X key, I laboriously reinvented the algorithm for using natural logs (\ln). Remembering

$$\frac{\ln X}{\ln b} = \text{LOG}_b X = N$$

and that the dB problems I was working used

$$M \text{LOG}_b X = NM$$

I was able to write

$$\frac{\ln X}{\ln b} = NM \quad \text{thus: } \ln X = \ln b(NM/M) \quad \text{or: } X = e^{\ln b(NM/M)}$$

I learned more about logarithmics from that absent 10^X key than I ever realized at the time. When Tom's H.P. 35 arrived on the scene with a 10^X key, RPN and a four memory stack, few of us realized this was just the beginning because it seemed to be the "living end."

Art Davis did not live to see the H.P. 35 but he did interface with my 9100A and found it very difficult to realize that I had not just copied the "K" number table into its memory and that it really was doing the computations that rapidly. When I set the switch to display 10 places and his tables only had 7, the knowledge that his tables were obsolete struck home. He never looked at the machine again but continued to use his tables and a huge mechanical calculator he had paid as much for as I had the H.P. 9100A.

Today's H.P. 41C's are direct descendants of Tom's original ideas and incorporate his latest thinking. My freedom in mathematics came through this man's genius and drive to take the drudgery out of calculation and allow the user to think about the problem, not the process.

Tom Osborne's paper had much of importance to say to those ready for it. As for the others, they are already deceased in any useful technological way.

AN IMPORTANT PAPER - W.B. JOYCE

William B. Joyce of the Bell Laboratories has published his *Power Series for Reverberation Time* in the Acoustical Society Journal, February 1980, pages 564-571.

Those Syn-Aud-Con graduates attending recent classes know of our high regard for the work of Joyce. This paper is, we believe, a landmark addition to Joyce's earlier papers on this subject. We quote the first paragraph from the Introduction:

For describing the geometrical-acoustics reverberation time T of an enclosure (or the geometrical-optics escape rate $A=1/T$ of light from a passive crystal) there are but two exact expressions in the literature. The Sabine formula,¹ as completed theoretically by Franklin,^{2,3} is simple to evaluate, but it has been shown^{3,4} to be exact (i.e., arbitrarily small percent error) only for sufficiently weak absorptivity ($A \rightarrow 0$). Alternatively, the integral equation with eigenvalue A (derived by Kuttruff^{5,6} for an isotropically absorbing randomly reflecting surface and then extended in Ref. 4 to arbitrary physical surfaces) is exact for any absorptivity, but it is difficult to evaluate accurately except for the simplest enclosures. Thus in the present paper we develop a third exact expression which has a given, arbitrarily small, error over a greater absorptivity range than the Sabine-Franklin expression and yet is easier to evaluate than the eigenvalue integral equation. The idea is to deduce from the integral equation a power series in the strength of the absorption. The leading term is found to be the Sabine-Franklin equation, and we thus interpret this result as a new derivation and an endorsement of their still controversial^{3,4} expression. The next term then provides a correction to the Sabine-Franklin value in many practical cases where their expression is fairly accurate but not accurate enough.

The entire philosophical underpinnings of reverberation theory is based upon "sufficiently weak absorptivity" and Joyce's work is an elegant theoretical proof of the observations we are now able to make with ETC measurements.

Joyce's paper should have substantial effect on the thinking portion of the acoustic community.

THE CONCEPT OF DISTORTION

At a recent West Coast AES section meeting Dick Heyser was one of the panelists and, as would be suspected, he had much to say that was original, worthy of mental effort, and fundamental to an understanding of the subject. The subject was "Distortion." The following is from a written handout Dick provided those attending this meeting and reproduced here with Dick's permission:

What is the meaning of this concept which we call by the name "distortion"? That is not a frivolous question, nor is its answer going to be trivial.

A thing to be considered distorted must be referenced against some other version of itself which can then stand as the measure against which distortion is to be based. A thing compared against another version of itself. Distortion is a term of relation.

We might consider that a signal which passes through a perfect time delay and emerges unscathed in anything but offset in time is distortionless. Or, we might consider that the signal appearing at the output terminals of a perfect amplifier is an undistorted replica of the signal at the same amplifier's input terminals. In both cases we tend to assume it is possible to bring the output and input into perfect congruence: in principle, if not in reality.

But this matter of congruence - of bringing together with coincidence everywhere - leads to barrels of snakes, and even the ancient Greeks were troubled by the concept of congruence. For if I do something to an entity so as to change it into another form, then I cannot say that this is the same as doing nothing to the original entity.

Any consideration of distortion as a deviation from identity of congruence if we relate input to output will eventually lead to difficulty. For one thing, the form of deviation from congruence will thus depend upon the particular signal we choose for our test. And we can never make general statements about the nature of such distortion. Clearly, we need to come up with something better for the concept of distortion.

If you're into mathematics, you should be shocked at this fact: the common measures of distortion used today are based on linear mathematics; hence are inapplicable to nonlinear situations.

Harmonic, IM, TIM and the rest are based on linear theory. So the present math is of no use in a general sense. (Ed: Italics mine)

Now let's consider this: the end product of audio is the listening experience. The end product is the result of perception, cognition, and valuation processes occurring in the mind. What things do we know about such processes? The answer is, very little. But there are a few observational facts about this which, when considered for audio, give pause for redefining the concept of distortion.

We know, for example, that words which are sung are perceived in a different manner than words which are spoken. Aphasia - the loss of ability to understand or speak words as a result of brain lesion - does not affect music. Where, in our present audio technology, can we measure a waveform and distinguish its message as that of language or music? The brain does it. And can we be so presumptuous as to assume that the same measure of distortion which we use for one such waveform (which we cannot identify) must also apply to the other waveform?

The left hemisphere of our brains and the right hemisphere play an incredibly complicated role in perception. A role completely ignored whenever we make a simple waveform analysis with audio test equipment.

I therefore suggest we take a different approach to the concept of distortion. I suggest we think of distortion as a change in the rules by which one thing is related to another. Distortion is a change in the type of geometry governing a process.

There are geometric rules which govern behavior of the physical world about us. I suggest that we, as sentient beings who participate in this world, tend to align our sensory observations so as to be consistent with this structured behavior. We learn through experience how to relate our sensory cues with the geometry of that which is about us. The geometry of perception will mimic the geometry of physical reality.

We speak of that which is "common sense," and indeed it is: the commonality of sensory related experience.

My own research into human nonlinear behavior has caused me to introduce three divisions to what is universally spoken of as "perception." These are the divisions of (1) sensory contact and stimulus, (2) association of stimulus with memory and past experience and ongoing stimuli of other nature, and (3) evaluation of stimulus in light of ongoing experience. I call them perception, cognition, and valuation.

SYNERGETIC AUDIO CONCEPTS

CONCEPT OF DISTORTION by Richard C. Heysler, continued

We can "like" something today and "not like" the same thing tomorrow - even though the program and stimulus were essentially identical in both circumstances. The perception was unchanged, but cognition and valuation were altered.

Contrast this against the audio measurement that assumes because the waveform was identical during the two auditions, the distortion was unchanged.

The geometry of physical acoustics obeys the laws of Euclid. Therefore the geometry of perception should likewise obey Euclid's laws.

If the stimulus which we are presented by an audio reproduction does not follow Euclid's laws, then, according to my earlier definition, a distortion has taken place. That is not unreasonable, but a terrific complication arises when we try to assess the geometry of perception; because this geometry has a higher dimensionality than that of our simple audio measurements.

It is far too complicated a subject to go into here, but a way to make such a distortion determination is to try to draw parallel lines in the perceptual space. Euclid's fifth postulate - the parallel line postulate - is a pivotal consideration in distinguishing Euclidean from nonEuclidean geometries as any level of dimensionality.

We set up a test signal which generates parallel lines in five dimensions, then see if the device under test warps the geometry to prevent us from generating parallel lines. Sounds complicated. It is complicated. But there are relatively simple audio tests which do that.

There is another consideration about our present, inadequate, measures of distortion. It is assumed, tacitly, that distortion belongs to a Markov process. A Markov process is one in which the future depends only on conditions in the past. Blowing a loudspeaker's protection fuse produces a distortion of the present (no sound) that resulted from a signal trauma in the past. And previous, as distinct from ongoing, signals can make themselves felt in the form of ringing, overshoot, and related inertia-like effects.

The world about us is full of nonMarkov processes. If your awareness of something is changed irrevocably by the introduction of some new piece of knowledge, then the altered awareness is nonMarkovian.

Perhaps nowhere is the concept of distortion more significant than in the peculiarly human endeavor which we call music. Trying to define distortion is very much like trying to identify quality of musical experience. A very nonmusically inclined technical person might try to identify music distortion as the thing called discordance. All dissonance is distortion; all consonance is distortionless. How utterly simple. How utterly stupid. Dissonance in the form of a passing chord is not dissonance. Or try to explain to a musician that his guitar amplifier cannot produce good music because it has more than 0.001 percent harmonic distortion.

Finally, I must point out that all is not black with regard to coming to grips with the concept of distortion. It's just that much of what we are doing right now in audio amounts to going down the wrong road. There are some pretty good math models which can be used to model behavior of humans under sets of control factors. And isn't that really what this business of distortion is about? Distortion, like beauty, is in the mind of the observer. Distortion is relative. Distortion may be introduced in a nonMarkov process - you become aware of something which then alters your valuation of the quality of the ongoing experience. Awareness of distortion can be a catastrophic process which is precipitated by a variety of control factors. And there is a nice math model which addresses all of these things. The math is called Catastrophe Theory. The math is a special form of geometry.

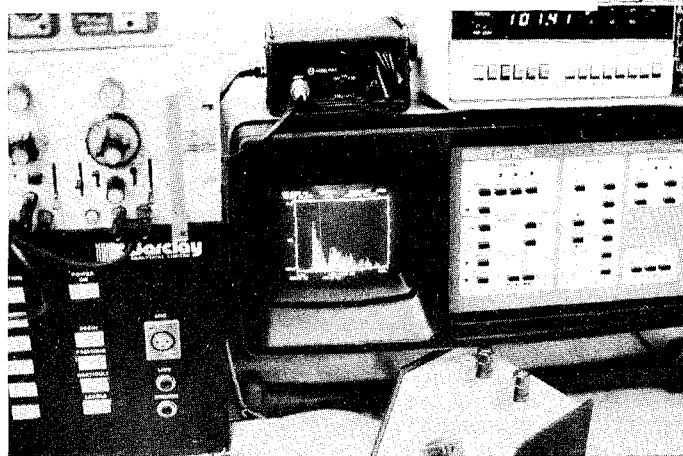
The bottom line of this, and the thing I would like to leave with you is that distortion deals with form, structure, and the relationship among things, and that a proper math model on which to base distortion measurements is that old fashioned discipline called GEOMETRY.

We present his paper in much the same spirit that Dick did - as mental "jars" intended to start us thinking about an audio subject we all intuitively feel we understand and which we probably are grossly underestimating.

ETC MEASUREMENTS OF THE BOSE 802

These two photographs were taken in a recent class where one of the participants brought in Bose's latest offering to the commercial sound field. We then received an elaborate brochure from Bose Corporation on this unit which, to our view, was a useful worksheet for applying the units.

As can be seen from the ETC photograph, these units are not time aligned™. Our guess is that the high density time smear (over 8 msec) provides a distinct tonal coloration that may well be acceptable to certain listeners.



Bose's new specification data (written for mailing to professional consultants) may be requested from

ROY L. KOMACK
 Manager, Professional Products
 Bose Corporation
 100 The Mountain Road
 Framingham, MA 01701
 Tel: (617) 879-7330

Syn-Aud-Con graduates will recognize the alphabet they are using: D_c , Q, %Alcons, etc.

A SOURCE OF ATTENUATOR PADS

A pad is a fixed attenuator made specifically to fit into a link circuit for the control of audio level. The public telephone companies are major users of pads and because they are, telephone supply companies develop both mountings and pads for sale to operating companies.

Plantronics-Kentrox is such an outlet. We have found their very small, reliable K-pads a most useful tool. They make mountings for from 1 to 72 pads, and the pads themselves are available in 0.2 dB steps from 0 dB to 22.8 dB; and in 1 dB steps from 23 dB to 30 dB.

These are the miniature pads we pass around in each Syn-Aud-Con class.

In small quantities they cost \$2.70 each and the mounting for two pads is \$18. We'd suggest that you contact Kentrox and work out a package suitable to your needs.

Kentrox Industries Inc. 14335 N.W. Science Park Drive, Portland, OR 97229. Ph 503-643-1681

FREQUENCY LIMITS OF HUMAN HEARING

Puddie Rodgers has demonstrated the ability to research deeply into complex audio subjects. She is a gifted and insightful researcher that we all will be hearing much more of in the future. She has asked Syn-Aud-Con graduates for help in preparing a bibliography on the frequency limits of human hearing. We'd like to encourage as many of you as have material on this subject to share it with Puddie. Write c/o Rauland Borg, 3535 W. Addison St., Chicago, IL 60618.

Several Syn-Aud-Con graduates have asked for a bibliography on psychoacoustics and she sent the following list with her invaluable comments, (1) an article by Dwight Batteau, "The Role of the Pinna in Human Localization" (This work was performed under the sponsorship of the United States Naval Ordnance Test Station, China Lake, CA) from the Proc. Royal Society 1967, p 158-180. "It was a reference to this man's work that precipitated my interest in the role of the pinna. Perhaps it was the fact that so many people were so quick to say that he was wrong without ever investigating his ideas. He wrote many articles but this is the most concise and is sort of a summary. (2) The second article was co-authored by one of my favorite people, Dr. Robert Butler. He is always about 5 years ahead of his academic peers. This is the paper which talks about using other peoples' pinnae. I think you will find this article to be beautifully written (his always are), enjoyable, and scientifically exciting: "Spectral Cues Utilized in the Localization of Sound in the Median Sagittal Plane" by Robert A. Butler and Drystyna Belendiuk from *The J. Acoustical Soc. Am.*, Vol 61, No. 5, May 1977. The last article is by P. J. Bloom. "Determination of Monaural Sensitivity Changes due to the Pinna by use of Minimum-Audible-Field Measurements in the Lateral Vertical Plane. *J. Acoustic. Soc. Am.*, Vol. 61, No. 3, March 1977."



COMMENTARY ON LEDE™ CONTROL ROOMS

Recent popular publications in the recording field contained a great deal of discussion relative to the LEDE™ concept. Unfortunately, these commentaries were written by men who at the time of their writing the articles had never seen or heard an LEDE™ control room and were totally innocent of any knowledge of TEF™ measurements.

Before discussing the errors of judgment and fact committed in these articles, I would like to first acknowledge the majority of professional consultants who have recognized the fundamental technical validity of the LEDE™ concept as well as those who are quietly reserving professional judgment until they have an opportunity to experience one of the rooms and witness a TEF™ measurement session.

The entrenched traditionalists, alarmed by the rapid spread of this new LEDE™ idea, their knee-jerk response is to prematurely attack what *they think* it is. In one case, the attempt to build live end, dead end *studios* some forty years ago was dredged up as a proof that LEDE™ *control* rooms are an old idea. In another case, it was *assumed* that we are recommending LEDE™ treatment at low frequencies.

The surprise to us is that, so far, all commentary has been unbelievably ill-informed as to our actual concept and the evidence is that a majority of these verbose individuals engaged in designing and building today's control rooms either lack knowledge of fundamental acoustic principles or, where in possession of them, mis-apply them. One author in spite of an abundance of real life Ω measurements for monitor loudspeakers proceeds to incorrectly use Bessel functions to obtain a non-valid directivity factor.

So far, all the comments we have seen published by the "old guard" of recording studio acoustic "experts" have had the following misconceptions firmly in mind:

1. That the LEDE™ approach can be used and is suggested for any size and type of room
2. That whatever LEDE™ does in a control room is intended for use at low frequencies
3. They all share a total unawareness of *initial time delay gap*
4. They feel "threatened" by the ever increasing number of owners engaging designers of LEDE™ control rooms.

The reason for considering the LEDE™ concept for a *control room* is to establish at the mixing engineer's ears a control room initial time delay gap (ITD) that is greater than the ITD of the studio. When this is accomplished, the mixer hears *only* the studio's early reflected *sound field* reproduced by the monitor loudspeakers and the control room's early reflected sound field is masked by the Haas effect temporal zone.

We along with anyone else aware of sound fields in small enclosures, divide the frequency range into wave acoustics for low frequencies and geometric acoustics for higher frequencies. The LEDE™ concept is applied at geometric frequencies only.

Critics of the LEDE™ concept are overwhelmed by the difficulties of handling the creation of a diffuse sound field originating from the rear of the space. We respect their confusion because prior to TEF™ measurements it was a very difficult undertaking. With TEF™ it is an embarrassingly straightforward task requiring only that the operator learn to adjust simple instrumentation.

We suggest you take with a "grain of salt" or perhaps not at all the ill-conceived remarks put forth by non-TEF™ licensees as it is manifest that they can't know what they are talking about when they can't see what is really happening, and what is really happening is counter to the treasured theories they have so laboriously misconstrued in the non-measurable labyrinths of their minds.

$$\frac{\partial^2 s}{\partial t^2} = \frac{E \partial^2 s}{\rho \partial x^2}$$

BASIC EQUATIONS FOR WAVE MOTION

is the "well known" differential *wave equation* of a periodic fluctuation in "s" which is propagated in the X direction at a velocity

$$c = \sqrt{E/\rho}$$

This same equation can be written

$$\frac{\partial^2 s}{\partial t^2} = c^2 \frac{\partial^2 s}{\partial x^2}$$

and

$$s = s_0 \cos 2\pi f(t - X/c)$$

is a solution of this equation as is

$$s = s_0 \sin 2\pi f(t - X/c)$$

To make life easier, the practice is to write

$$\omega = 2\pi f$$

$$K = 2\pi f/c = 2\pi/\lambda$$

Where K is referred to as the wave number

Taking the sum of both

$$s = s_0 \cos(\omega t - KX) + j \sin(\omega t - KX)$$

Since

$$\cos \theta + j \sin \theta = e^{j\theta}$$

it is permissible to write

$$s = s_0 e^{j(\omega t - KX)}$$

This exponential form has the advantage of being easier to manipulate mathematically, but the disadvantage that most of us find is that it is much harder to *visualize* its physical meaning.

Dick Heyser normally uses the exponential form in his "chalk talks" and some familiarization with it is helpful in following the discussion.

SPECIAL TEF™ CLASS TENTATIVELY PLANNED

We now have on hand about 15 applicants for a special TEF™ class with Dick Heyser. We expect this to grow to over 20 applicants by early fall.

Crown International announced at the May 1980 AES Convention that they are building a "dedicated" TEF™ instrument under license to Cal Tech. We are hoping to have a prototype of this instrument available for the special TEF™ class late this fall or during the early winter season. This class will be held in California and will cost \$750. The charge includes lunches, dinners, coffee breaks, special classroom material and your hotel room for three nights at the Marina Inn, Dana Point, CA.

Attendance will be limited to the first twenty applicants who respond to the special letter that will be sent to TEF™ licensees who have written us indicating a desire to attend such a class. There will be no public announcement of this class and successful applicants will be contacted directly by Syn-Aud-Con about 60 days prior to the actual meeting.



TDS-Heyser class, May 1979



TDS-Heyser class, November 1979

TEF™ licensing will cease upon delivery of the first Crown dedicated TEF™ analyzer to the market place. The dedicated instrument's price includes a royalty to Cal Tech. Therefore, if you wish to be one of that select number licensed to legally build an experimental TEF™ system you need to apply in the near future. TEF™ licenses are for the life of the patent and cost \$500. This price includes the special interface box for converting an FFT analyzer into an ETC analyzer and a special Syn-Aud-Con manual on TEF™ techniques and procedures.

Since the Crown unit will have TDS, ETC, and phase measurement capabilities, we are all looking forward to its availability with a great deal of excited anticipation. TEF™ technology will take a major step forward with a dedicated, reasonably priced (hopefully in the \$8000 range), full capability instrument.

The wailing and gnashing of teeth among those unfortunates whose work will then be analyzed in detail by users of such an analyzer will be one of the more violent periods in audio history. Look what an uproar such a simple idea as LEDE™ has caused among the recording industry "cave dwellers" and you can begin to appreciate the impact the dedicated TEF™ instrument is about to have. In an industry genuinely confused about phase vs polarity, viewing both absolute and relative phase of sources directly on the analyzer screen should be shattering.

Of course, it is necessary to remember that these same incompetents will simply try to ignore the entire situation (much akin to ignoring Mount St. Helens if you live at its base) and that's where the true excitement comes in. Those who know what's going on will gradually replace the obstructionists and the entire industry will move forward.

Are we excited about the next TEF™ class? You bet!

NEW TEF™ LICENSEES

Mr. David Wright
Ambient Sound Studios
806 University Ave
St. Paul, MN 55104

Ms Mary C. Gruszka
88 Myrtle Ave
Edgewater, NJ 07020

Mr. Leo Young
The Radio People, Ltd.
25, Chatham Rd. South
PO Box 6131
Tsim Sha Tsui Post Office
Kowloon, HONG KONG

Mr. Richard Zwiebel
High Country Sound
Box 886
Lyons, CO 80450

Mr. Henry Behrens
747 Nightingale Rd.
West Hempstead, NY 11552

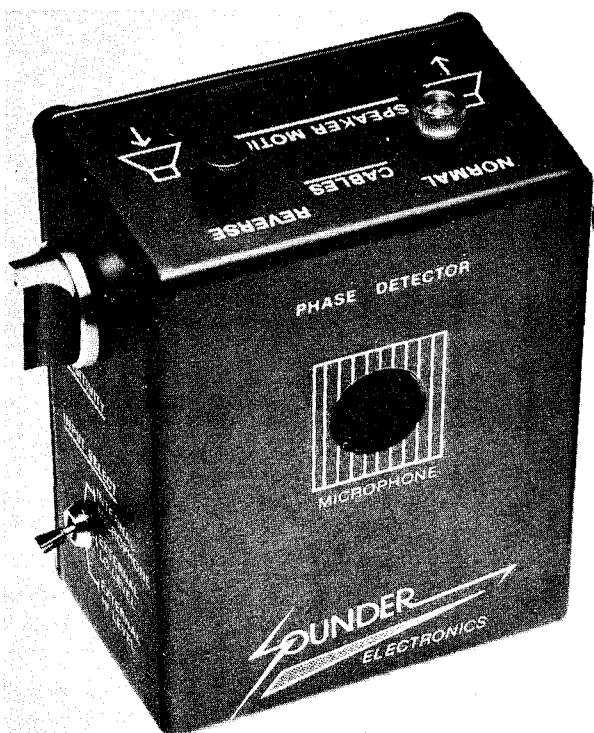
"PHASE" CHECKER FROM SOUNDER ELECTRONICS

We have been using an interesting polarity tester in recent classes from Sound Electronics in Mill Valley, CA. Unfortunately, it is labeled a "Phase Checker." A Dymo tape readily remedies this blemish. So far our use of the unit indicates that the mislabeling is Sounder Electronics' only serious fault.

The tester (I'll call it Polarity Checker henceforth) consists of two units: (1) the detector, Model 250; and (2) the pulse generator, Model 500. The detector has its own microphone built in or can accept other microphones or line level signals.

The primary fault simple units of this type exhibit is that they are easily confused by early reflections and other unexpected signals that appear in the time window they are using for their detection of the pulse. This unit has proven to be relatively immune to most of these interferences so long as you stay out of the near field of the loudspeaker you are testing.

For truly definitive testing of polarity and simple time displacements we'd recommend AL FEIERSTEIN's



IMPulser at \$225. (See Newsletter Volume 7, No. 3, page 6.) Al's unit has the very real advantages of being frequency adjustable and allowing meaningful viewing of the waveform on your oscilloscope.

The suggested retail price for the Sounder Electronics detector unit (Model 250) is \$295 and for the pulse generator (Model 500) \$495.

The advantage of the Sounder Electronics' units is that it is easy to teach untrained personnel how to use it effectively.

CHARASROJ BOTHADAMRIH



Our May 15th class had a participant from Bangkok, Thailand, Charasroj Bothadamrih, (Bo is an architect).

We are always impressed by the high level of competence and devotion to learning our overseas visitors exhibit.

In a world increasingly dependent upon communication of every sort its hard to imagine any corner of our globe without some form of audio and, when you add a need for the understanding of basic acoustics, then the application is indeed universal.

We are always pleased to meet these audio pioneers from other countries.

SYN-AUD-CON FRIENDS



Without KEN WAHRENBROCK there would have been no PZM systems. Ken's contagious enthusiasm for the entire recording process and his remarkable intuition as to where the next step lies combined with his total integrity often make the very difficult seem easier than it really is. Ken has been active in helping us teach Syn-Aud-Con classes for the past 1-1/2 years and any graduate of these classes can quickly tell you what an asset Ken has become.



Ken's daughter, SANDRA WAHRENBROCK (Sandi), is his main assistant in the operation of Wahrenbrock Sound Associates and she often drops in on Syn-Aud-Con classes to meet the many PZM customers in attendance. Sandi is a Syn-Aud-Con graduate and has recently tried her hand at doing "live mixing" for "The Music Man" at the Downey Civic Light Opera.

Jan Kreitz is Syn-Aud-Con's office manager and is the pleasant voice you often hear when making a phone call to Syn-Aud-Con. Jan handles the details of your travel to Dana Point, your Newsletter mailings, Syn-Aud-Con registrations, along with the help of Jeannie.

VOLUME OF A CORNER BAFFLE

Here's an answer to our question on the volume of a corner baffle. (Vol 7 # 3, page 26). Jim Johnson of Acoustic Design Associates in Dallas. (Jim's partner is graduate PAUL MORROW.)

This one's pretty easy, Don.

If the side of the trihedral speaker baffle is S,

$$V = S^3/12\sqrt{2}$$

(Turn the room over so you're looking at a right triangular prism whose height and 2 lets are equal. Each leg is $S/\sqrt{2}$, and so is the height.

The volume is $1/3 \times$ height times area of base:

$$\frac{1/3 \times S/\sqrt{2}}{1/3 \text{ height}} \times \frac{(S/\sqrt{2})^2}{\text{base area}} = \frac{S}{3\sqrt{2}} \times \frac{S^2}{2} \times 1/2$$

On a TI 58 or 59, assuming S is in inches and you want V in cubic feet:

```
*Lb1 A      Enter S
:12=        Press A
y^x 3 =
:12:2√x =
R/S         Display cu ft
```

If you are given volume in cu ft., and want S in inches:

```
*Lb1 B
x2√x x 12 =
y^x 3 1/x =
x 12
R/S
```

AUDIO GREATS

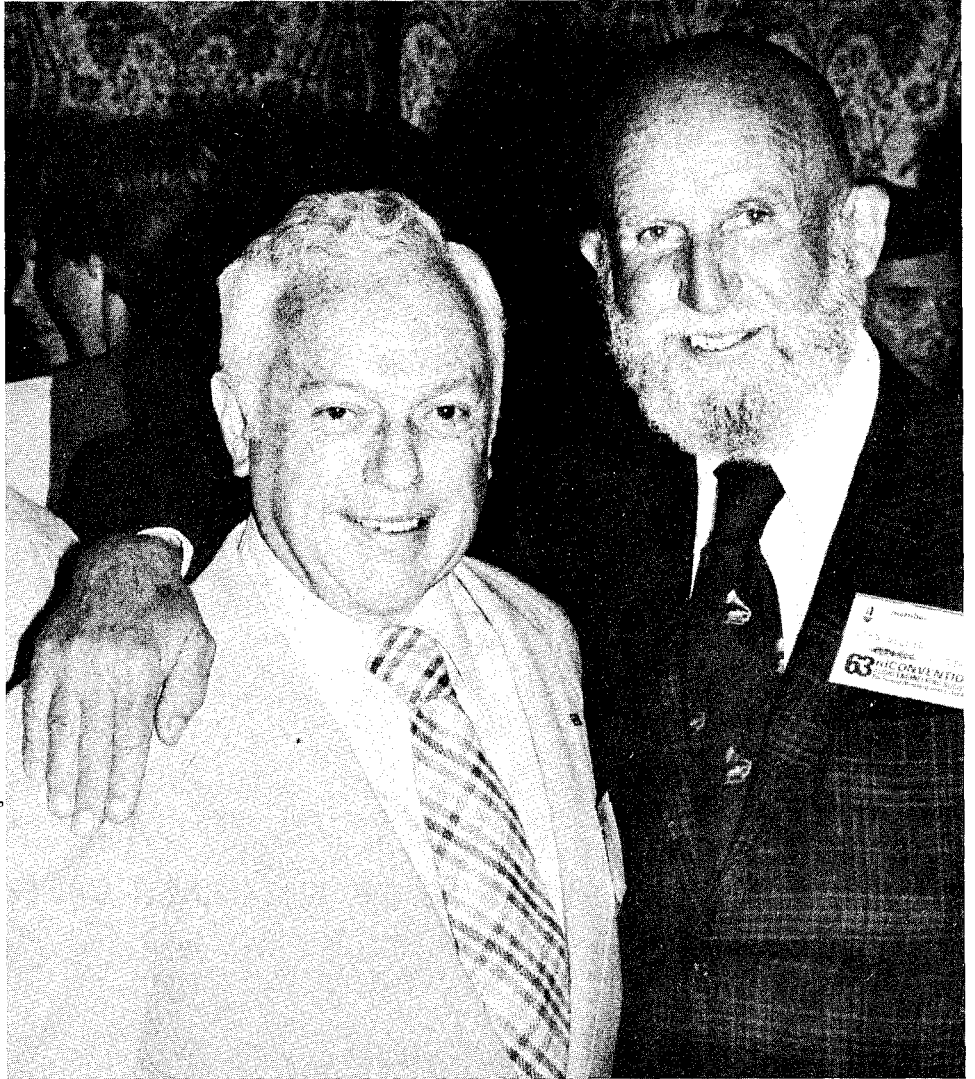
HAROLD LINDSAY (left) and John "Jack" Mullin (right) represent the practical origin of magnetic recording on tape in the United States. Yes, there were predecessors as in all endeavors. The fact remains that these two men jumped through the veil of theoretical possibilities into the realm of real life products on an unmatched professional basis.

John Mullin "liberated" the professional level Magneto-phon recorder from "the radio station on a railroad train" the the Hesseser Rundfunk (Frankfurt, Germany) used to avoid being bombed out. John brought the unit home after the war and demonstrated it to an IRE (one of the forerunners of the IEEE) meeting in San Francisco. Harold Lindsay was at that meeting and became both enthused with the possibilities of tape recording as well as inspired with ideas of how to materially improve the process.

Harold talked Alexander M. Poniatoff (the AMP of Ampex) - the EX stands for excellence) into converting his company for making electric motor devices during the war into a tape recorder manufacturing plant.

John Mullin later played a major role in the development of the 3M tape recorders, as well

Rarely have two men had as major an effect on the start, growth, and continued direction of a major industry. What's even more interesting is that these two men are as close friends as they appear and both are as pleasant as they seem to be in this picture.



Another trait they both possess to a remarkable degree is a deep interest in the history of all audio. (John Mullin's audio collection has been a treasured feature at AES Conventions.)

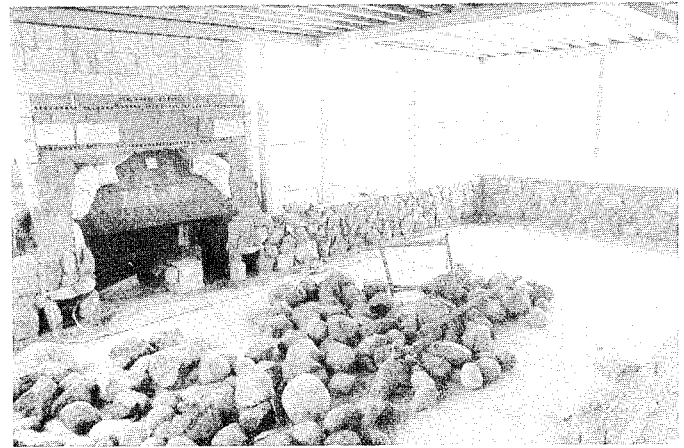
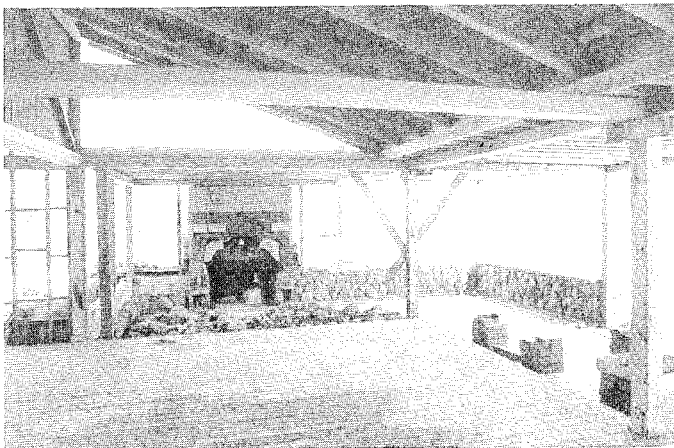
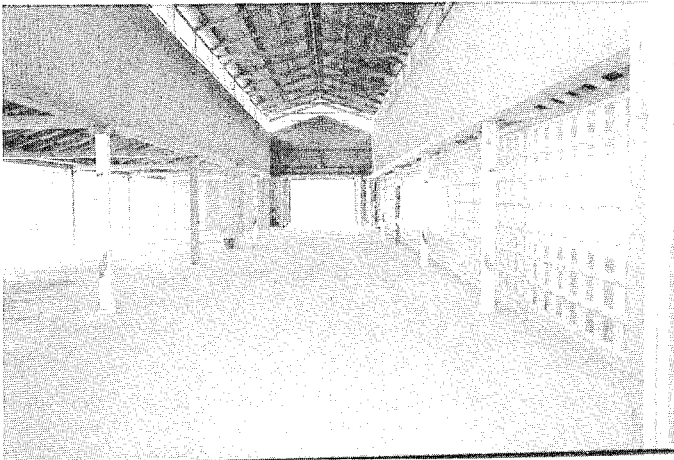
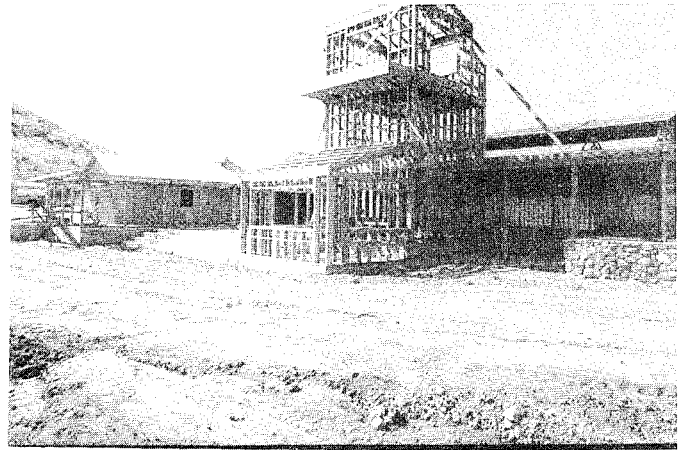
In the thoughts of many who are without experience in the world of business, successful men are often considered as cold, hard, ruthless, and in pursuit of self-interest alone. These two men are living refutation of such accusations. They are successful in the true meaning of the word. They have lived adventurous lives filled with the creation of thousands of jobs for others, service to their communities, country and friends. That they are also considered successful in the material things of life is really incidental to the overwhelming productivity of these two men. No wonder they can look out at us from this picture with such equanimity and assurance.

ERRATA

GLEN BALLOU insists that if we make a mistake in a publication we have to correct it in the next issue. OK. Newsletter Vol 7 # 3, page 5, the formula in "Why Align Speaker Arrays" should have read:

$$\frac{(1130') (12'') (sec)}{(sec) (1) (10^6 \mu sec)} = \frac{.0135''}{\mu sec} = .135''/\mu sec$$

MORE ABOUT THIS LATER



NEW INTELLIGIBILITY TEST FROM NOSC

The U. S. Navy has added to Syn-Aud-Con lore with an addition to the "Joe took father's shoe bench out" school of intelligibility testing.

CRAIG ALLEN at Naval Ocean Systems Center, NOSC, in San Diego (you'll be hearing more about this man's special skills in the near future) uses the following paragraph during the testing of exciting speech processing equipment he has conceived and built. We hope we can entice a Syn-Aud-Con Tech Topic from him soon discussing his particular approach to speech processing.

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

CHOOSING A MEASURING MICROPHONE (It's not as simple as it seems)

Recently one of the most active studio designers pontificated in a new studio publication on the need for a random incidence calibration of a microphone for use in control room measurements.

Apparently it has not occurred to him that TEF™ measurements *are* free field measurements and that only those limited to measuring L_T and L_{AMB} by means of 1/3 octave analyzers in rooms with a *semblance of reverberation* need to heed his advice.

If the measuring engineer, in distinction to a measuring designer, uses the B & K 1/4" pressure calibrated microphone, he will get the same response in both free, pressure, and random fields well past 20KHz making the entire discussion academic.

The level of misinformation in today's recording studio publications is so high that it is improbable that it ever will get straightened out for a majority of the practitioners engaged. More's the pity because it is not a difficult acoustic problem today once the correct tools are in the practitioner's hands. TEF™ in the hands of users incapable of grasping simple acoustic fundamentals leaves the user with vastly more data he doesn't understand. The first task of a TEF™ licensee is to use the instrumentation to instruct himself in these fundamentals.

CRITICS

Constructive criticism can, if properly received, be helpful. The basic trouble with critics is that you first have to "buy" that they have the authority and experience to fill the office they claim. This is so rarely the case as to make them one of the more outstanding groups of self-hypnotized incompetents.

An outstanding example of a critic completely out of his field of expertise and bereft of even the rudiments of investigative reporting was Martin Bernheimer's review in the Los Angeles Times of the Beverly Sills concert that inaugurated the public use of Dr. Robert Schuller's "Crystal Cathedral" for concert purposes.

Bernheimer's reviews seem to turn negative whenever religion is involved and an ego the size of Schuller's brought out hissing, coiling, and rattling on the part of Bernheimer to an even greater degree than normal. This critic normally prefers to inject his venom with less fanfare but in this review he struck repeatedly, tried to play boa constrictor as well, and then defecated on the remains.

"The Crystal Cathedral is an acoustical fiasco. A 16.8 million dollar disaster. It must be the world's fanciest 10,000 window echo chamber," was one of his gentler remarks.

Why do we disagree? Here are some facts we found out by simple inquiry as could have Mr. Bernheimer if he had wished to.

1. Beverly Sills sounded fine without a sound system but her voice was too weak to sustain the necessary level for a full concert. We attended a Beverly Sills concert at the outstanding 1200 Ambassador Auditorium in Pasadena a couple of years ago. Sills was able to project her voice for only a very short one hour concert.
2. The pew-back system planned for the building is not in yet and the headstrong Dr. Schuller hired a rock concert system for the evening.
3. The reverberation tests in the Crystal Cathedral indicate a beautifully diffuse controlled reverberant sound field that should be superb for Cathedral type concerts (choirs, choruses, organ, orchestras, etc.).

Moral? Let's all wait until the building *and* its sound system are completed before rendering judgment and then let's proceed from facts, not fancy.

We believe that DAVE KLEPPER has done an excellent job for this church. When his specially designed Industrial Research time delay units driving the pew-back speakers are in use, the building will be judged as acoustically well-designed in meeting its goal as a traditional Cathedral acoustic, suitable for the music intended for such environments.

DANA POINT CLASS - MAY 1



DANA POINT CLASS - MAY 15



ETC PLOTS

Frequency time curve (FTC) plots can be obtained in the following manner. A display on the ETC analyzer (modified FFT unit) will look like Figure No. 1. By placing the FFT cursor on each line of the "time smear" one at a time and then tuning in the 10 Hz mode to that line followed by the spectrum display of it on the TDS analyzer allows you to visually inspect which frequency area has the highest amplitude at the specific offset frequency indicated for the line tuned to on the FFT.

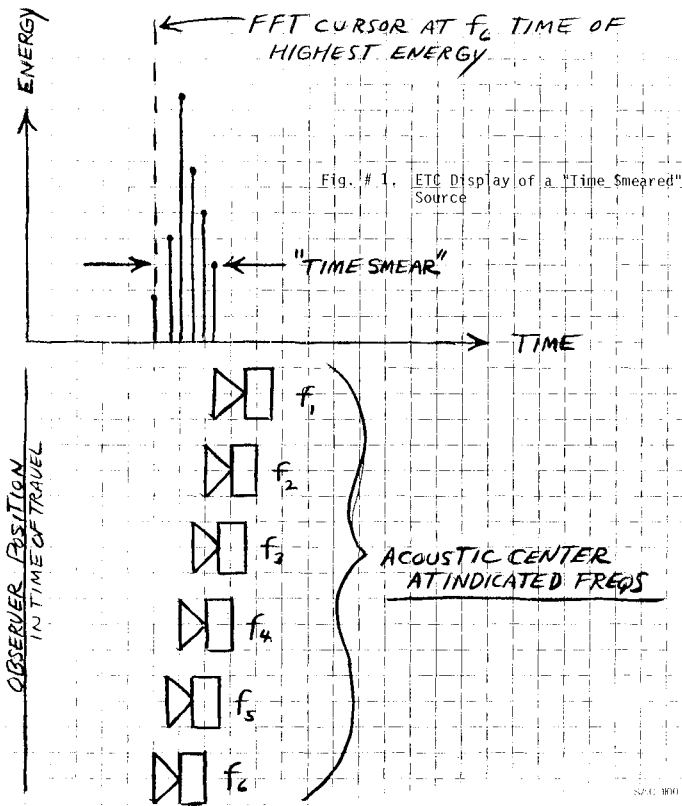


FIGURE NO. 1

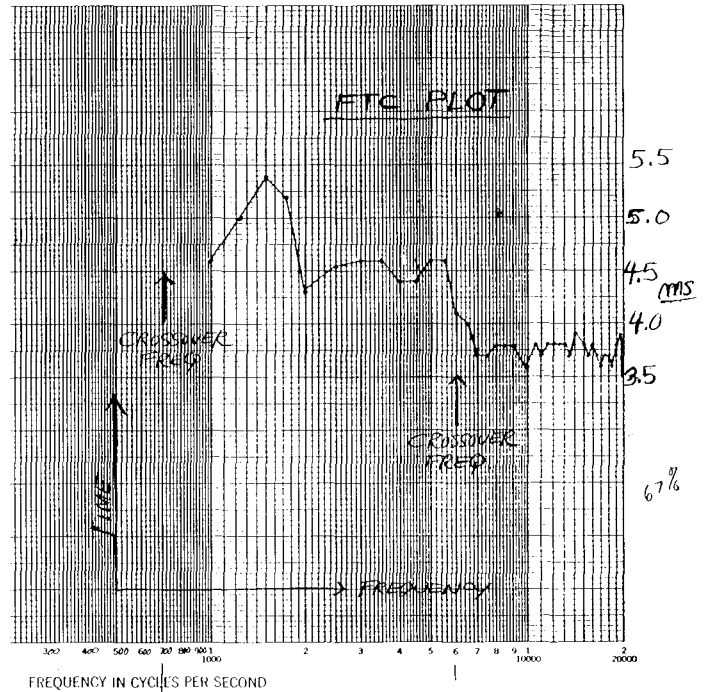
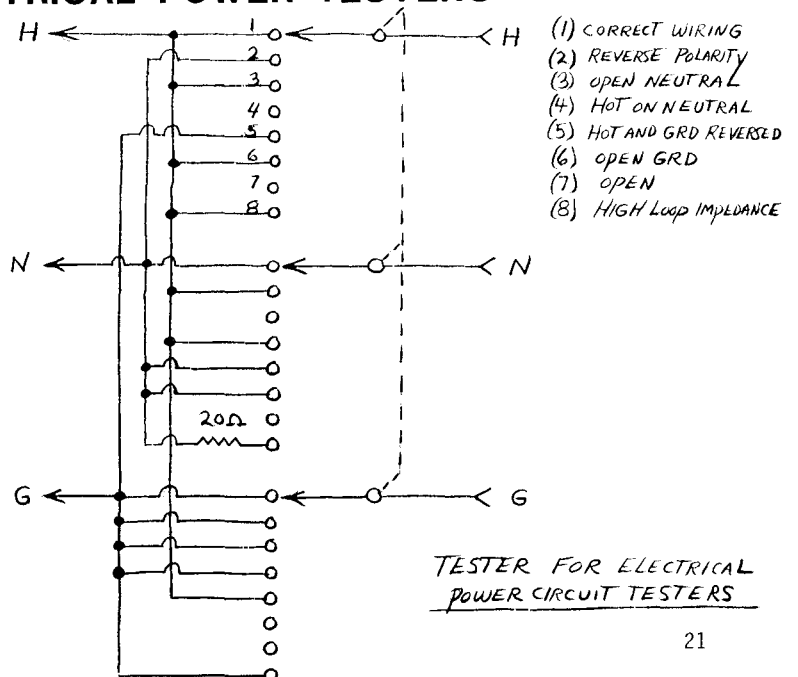


FIGURE NO. 2

The curve shown in Figure No. 2 was plotted by FARREL BECKER from measurements of a popular mid-range horn used in a medium sized "home" type loudspeaker. This acoustic source varied well over one foot at varying frequencies though the diaphragm remained physically in the same location. We are told by Dick Heyser that all horns cause time delay effects with frequency variation.

TESTER FOR ELECTRICAL POWER TESTERS

Ken Wahrenbrock built up an extremely handy tester for electrical power testers. You will be surprised how many of them fail to indicate correctly. Only the Woodhead Ground Loop Impedance Tester (GLIT) detects the problem at position 8 on the switch. This tester is well worth the time it takes to assemble and it can be a lifesaver.



TROUBLESHOOTING LARGE SOUND SYSTEMS

Over the years an occasional article appears written by someone fresh from the road experience of every-other-night setups or similar experience with temporary sound systems. Their descriptions of setting up and troubleshooting such systems are often helpful and offer insights into the tools, both mental and material, in use in the field today.

Suppose, on the other hand, you were to inherit a large audio system to maintain and expand. How do you go about establishing personal mastery over the system, what tools are most useful, and what order of attack is usually the most efficient?

GAIN OVERLAP CHART

Our normal first step is to analyze the single line block diagrams of the system and make "gain charts" if they do not already exist. "Gain overlap" charts for the major electronic components is well worth the effort. We calculate the approximate acoustic gain we should expect to find. Quite often this preliminary overview of the design of the system provides a starting point for physical inspection of it by pinpointing a design error or questionable practice.

Physical inspection, in our case, begins with a careful examination of the electric power sources with the ground loop impedance tester (GLIT). This is a good procedure because both the operators' and performers' safety relies on proper interface with the electric power system.

MONITORING OVERALL EFFECTS

Typically, we then connect an oscilloscope across the output of the system so we can instantly observe any degradation in the 1000 Hz sine wave test signal used to ascertain signal continuity, level, impedance, purity, freedom from oscillation, etc. It is common practice to work from the output of each power amplifier to its input (isolated from the remainder of the system) and then section-by-section back to the front end.

CHECKING POLARITY

In a permanent system it is well worth-while to maintain a known polarity through each and every component in the system. This practice makes the interchange of components a relatively straightforward procedure. Impedance of all lines is measured and recorded. Quite often the first indication of trouble in a complex loudspeaker array is a minute shift in impedance.

Noting on the single line block diagram the level in each link circuit, impedance, polarity convention, gain or loss of components, and, where applicable, the maximum allowable distortion figure can be an inestimable aid in future maintenance and in interconnecting devices used by visiting artist's soundmen.

ACOUSTICAL TROUBLESHOOTING

While 1/3 octave RTA's are still an excellent way to monitor L_T , they can provide little of value in adjusting the temporal alignment of loudspeakers. We are finding that the TEF™-EFC display is most useful in adjusting the least detrimental overlap of two loudspeakers' polar responses, while the TEF™-ETC display can perform seeming miracles in adjusting coverage that increases the ratio of direct-to-early reflected sound with the resultant audible benefits.

The literature on psychoacoustics is increasingly revealing that the minute temporal offsets we are discussing do not show up in human perception on the time scale but rather their resultant cancellations cause easily heard frequency response aberrations.

We would again point out, at the risk of being tedious, that large arrays *must* be adjusted one driver at a time and not as a total array if optimum results are to be achieved.

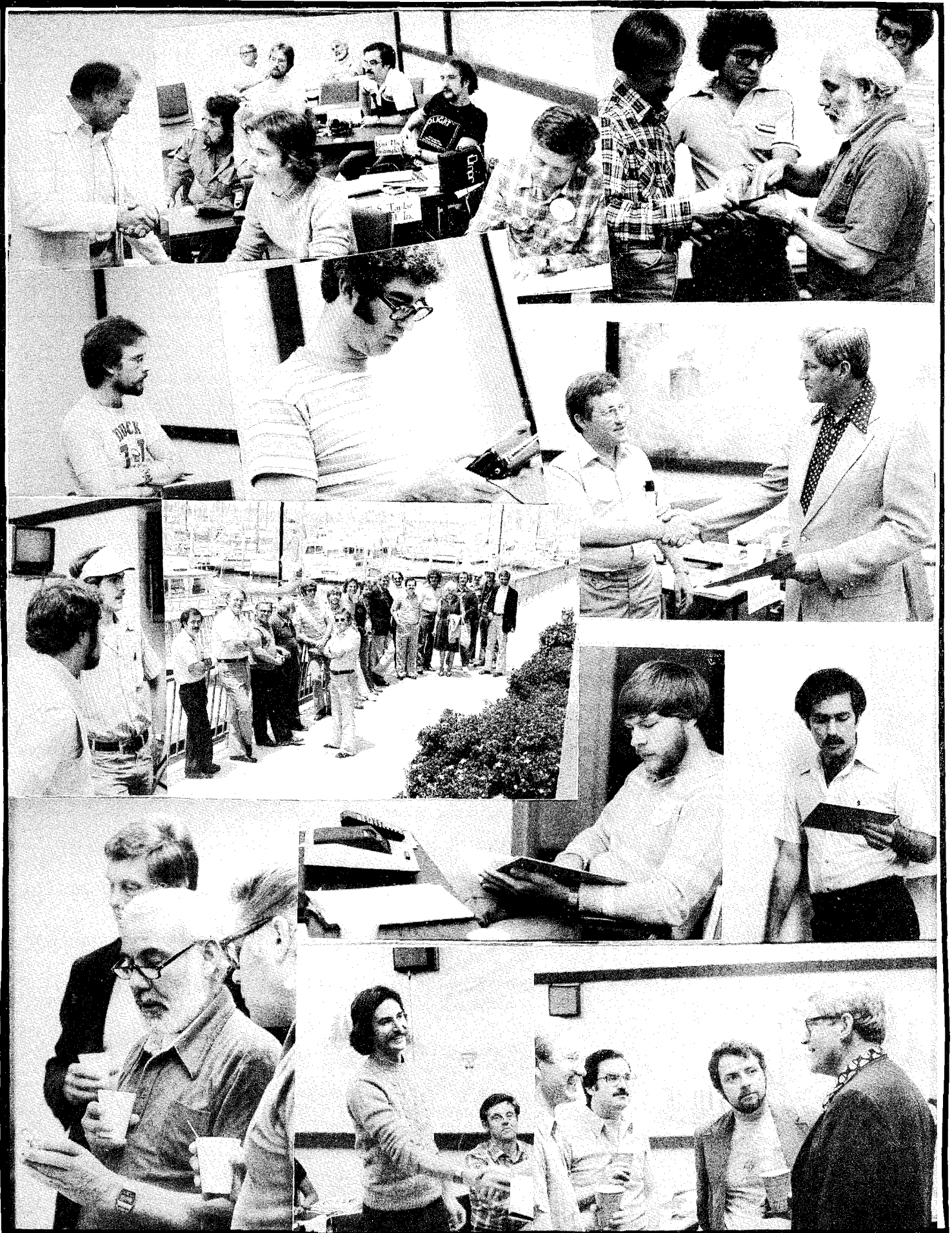
Typical Troubleshooting Equipment

1. An oscilloscope
2. An audio oscillator
3. A wave analyzer, both for TEF™ work and as a way to inspect distortion components. We do not suggest the use of notch filter analyzers for audio *system* work
4. An FFT analyzer for ETC displays
5. A precision sound level meter
6. An AC microvoltmeter
7. An 1/3-octave battery operated RTA
8. A polarity tester. The Acoustilog IMPulser is a fully satisfactory way of handling this phase (pun) of the measurement
9. A handheld scientific calculator for gain and level calculations
10. The necessary but often overlooked auxiliary pads, transformers, and interface boxes that allow correct interfaces to the many impedance, level, balance, and other circuit variations encountered in real life systems vs books on measurements.

Conclusion

It has been our experience over the past thirty years that there are far greater differences in system performance between the way they are checked out upon installation than will ever be observed between differing brands of equipment.

DANA POINT CLASS - JUNE 15



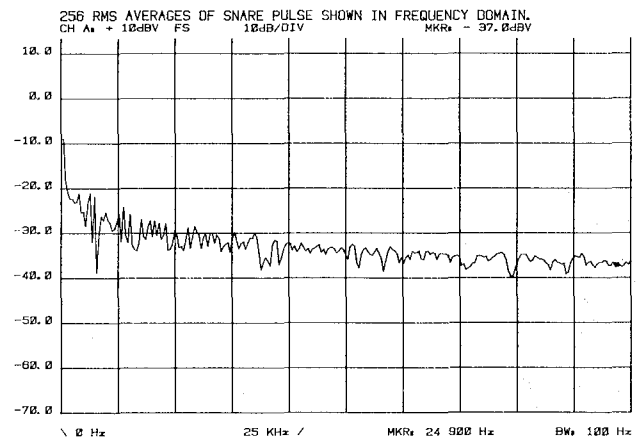
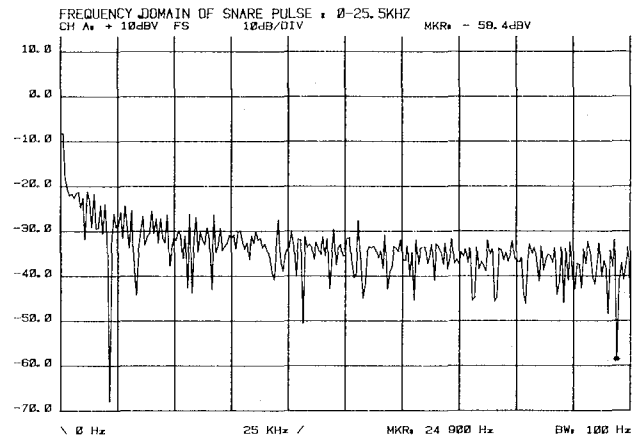
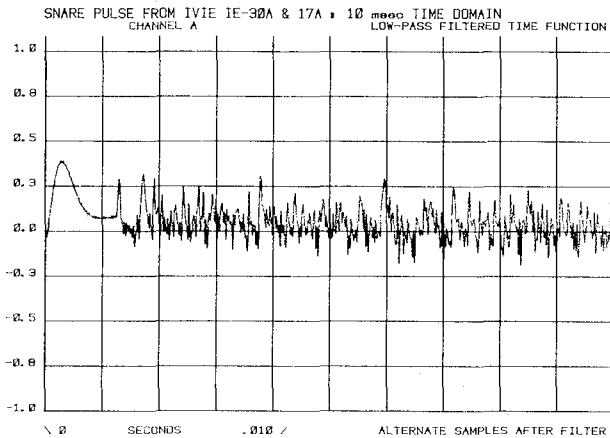
IVIE SNARE PULSE ANALYSIS

JOE MITCHELL of Schaumburg, IL, is both a Syn-Aud-Con graduate and a TEF™ graduate. He is unusually well equipped with acoustic test equipment including an FFT analyzer.

More importantly, Joe is exceptionally well equipped with technical knowledge in the use of such instrumentation.

The three charts were made in his analysis of the IVIE Snare Pulse signal.

We feel this information can provide valuable insight into the inherent qualities of this type of source and recommend careful study of this data should you use this instrument.



POTPOURRI OF PASSING PROJECTS

*HP adds IEEE-488 interface to HP85 for \$385. The Model 82937A interface fits into one of the four rear slots in the HP 85.

Further a \$295 ROM performs the necessary input/output functions to make the HP85 into an instrumentation controller in much the same manner as their larger HP9835A units.

*Ken Wahrenbrock tells us that the source for that excellent flexible cable we use as microphone lines in our present classes is: Belden 9397 - 2 wire and Belden 9398 - 3 wire.

These are double shields with one spiral wrapped in one direction and a second spiral wrapped in the opposite direction.

*Someone recently asked for Don's test sentence: "Joe took father's shoe bench out for a canoe ride down the Tippetcanoe River in a twin screw stainless steel cruiser.

*Carl Dorwaldt recently was surprised by a number of his colleagues with a Twentieth Anniversary party at Rauland. It's good to hear of celebrations of earned and deserved honors.

*Communications Company Inc., 3490 Noell St., San Diego, CA 92110 has put out a "full line catalog" of equipment manufactured by them. They are best known to Syn-Aud-Con graduates for their excellent low cost real time analyzer that turns any oscilloscope into an RTA. The latest version boasts dual integration (fast and slow). Their four page brochure contains a number of most useful and often hard to find audio accessories. One that is most useful is the "projector patch" for connecting any film projector to any audio system. A "must" catalog for the sound contractor.

*The Acoustical Society Convention will be held in Los Angeles, November 17-21, 1980. There will be a special session, "TDS and Microprocessor Applications to Room Acoustical Instrumentation". Richard Heyser will give an invited paper. Heyser doesn't take such assignments lightly and we expect a landmark paper.

*Ken Wahrenbrock purchased a Production Devices sweep generator, Model 150 for \$85. We have been using it in Syn-Aud-Con classes and it is excellent. Production Devices, 7857 Raytheon Rd., San Diego, CA 92111

THE PHASE OF A SINGLE DRIVER

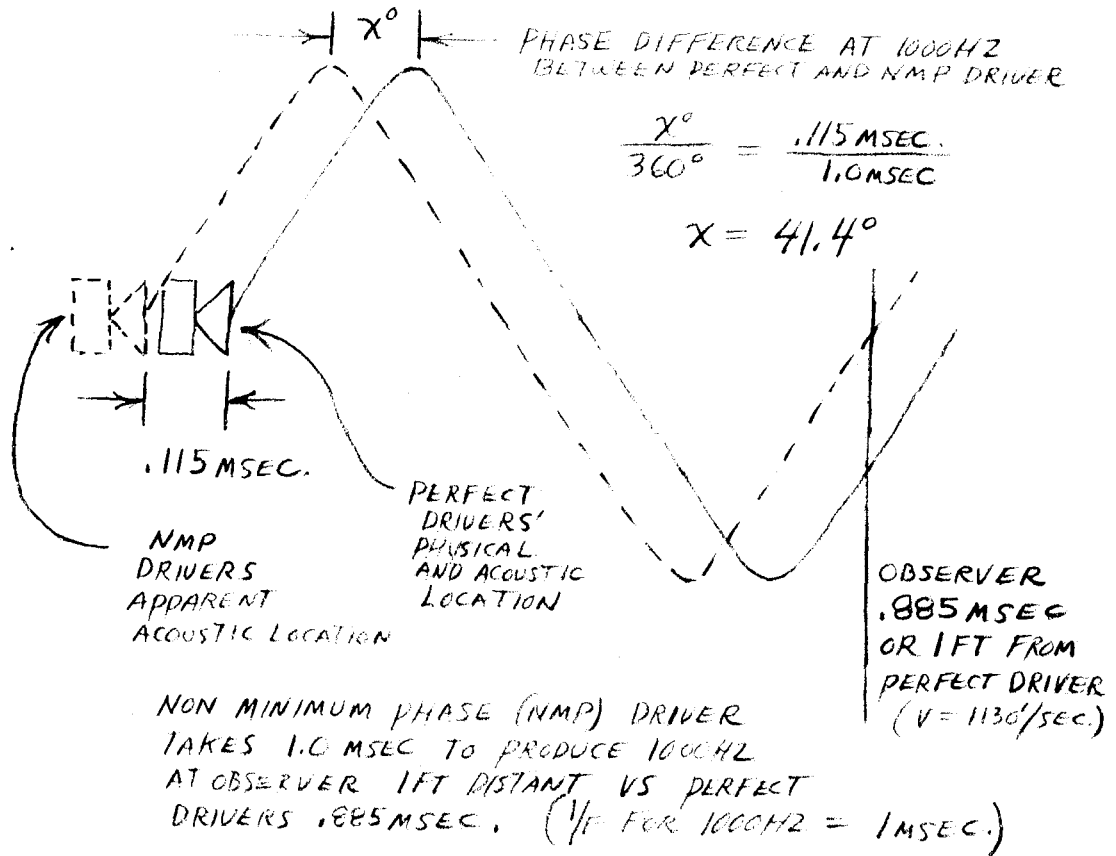
When all frequencies that a driver emits take exactly the same length of time to reach a listener or measuring microphone - this is the preferred situation.

For instance, if the sound velocity is 1130 ft. per sec. and the measuring microphone is 1 foot from the perfect driver, each frequency of a swept sine wave signal would, no matter how slow the sweep, take

$$\frac{1 \text{ sec}}{1130 \text{ ft}} = .855 \text{ msec to travel the 1 foot.}$$

Frequencies that took longer would be said to lag in phase *relative* to the ideal time. If the time delay between driver and microphone is also accounted for and then the relative delay added to it, you have the absolute phase shift for that frequency.

As an example, let's say that the frequency of 1000 Hz arrives in 1.0 msec rather than in the expected .855 msec. By this we mean that the physical distance between the acoustic center of the driver and the observer is, for the sake of this example, found to be .855 msec distant for other frequencies but 1.0 msec seeming distance for 1000 Hz. This discrepancy can be plotted as a relative phase shift or as a relative time offset. Obviously, like all phase shift phenomenon, the effect is frequency dependent.



RELATIVE PHASE SHIFT OF A NON MINIMUM PHASE DRIVER

In classes an occasional inquiry is, "How can the ETC display a fixed time display when the different frequencies are emitted from the loudspeaker at differing times as the sweep moves upward in frequency with time?" The answer, of course, is that we are displaying the transit time between the loudspeaker and the microphone and not the total time from the emission of the first frequency.

The question, however, is an indication that the questioner is understanding the basic concepts and it is a good legitimate question. It also brings thinking around to the simplicity of the ETC display that is based on a very beautiful, if not immediately intuitive, physical relationship.

AUDIO ENGINEER'S DICTIONARY

JOEL GREAD of WED in Burbank sent us "An Audio Engineer's Dictionary," a marvelous document to which we can only append, "How true."

In order to clear the murky waters and dispel the aura of mystery associated with the nebulous terms inherent in today's Madison Avenue-style marketing techniques now being leveled at the audio industry, a special dictionary of terms is necessary. It is hoped that these translations will permit a better understanding of such copy.

NEW Different color from previous design.
 ALL NEW..... Parts not interchangeable with previous design.
 EXCLUSIVE..... Imported product.
 DESIGN SIMPLICITY..... Costs cut to the bone (manufacturer's).
 FOOLPROOF OPERATION..... No provision for adjustment.
 ADVANCED DESIGN..... Ad man doesn't understand it.
 IT'S HERE AT LAST..... Rush job; nobody knew it was coming.
 FIELD TESTED..... Manufacturer lacks test equipment.
 HIGH ACCURACY..... Unit on which all parts fit.
 DIRECT SALES ONLY..... Manufacturer had argument with distributor.
 YEARS OF DEVELOPMENT..... Finally got one that worked.
 UNPRECEDENTED PERFORMANCE..... Nothing we had before ever worked like this.
 REVOLUTIONARY..... It's different from our competitor's.
 BREAKTHROUGH..... We finally figured out a way to sell it.
 FUTURISTIC..... Can't figure out another reason why it looks as it does.
 DISTINCTIVE..... A different shape or color than competitor's.
 NO MAINTENANCE..... Impossible to fix.
 REDESIGNED..... Previous faults are corrected (we hope).
 HAND CRAFTED..... Machine that assembles it is operated without gloves.
 PERFORMANCE PROVEN..... Will operate through warranty period.
 MEETS STANDARDS..... Ours, not yours.
 SATISFACTION GUARANTEED ... Manufacturer's, upon receipt of check.

We made some additions:

TEMPORARILY OUT OF PRINT... If we can sober up the author there will be a second edition.
 20,000 COPIES IN PRINT..... Wish we could sell some of them.
 ULTIMATE..... It's the last design that engineer will do for us.
 DEFINITIVE..... Play by our rules or we won't play.
 UNIQUE..... Who else has a holeless toilet seat?

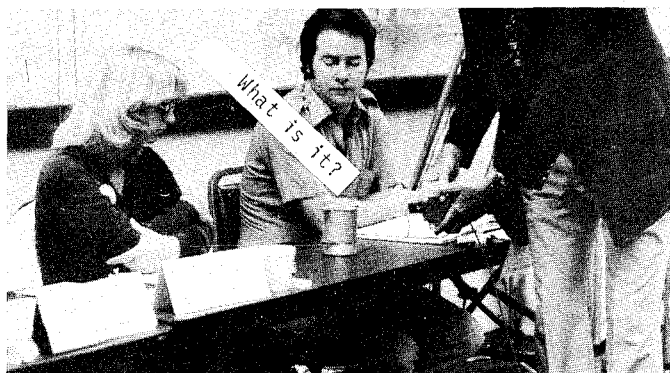
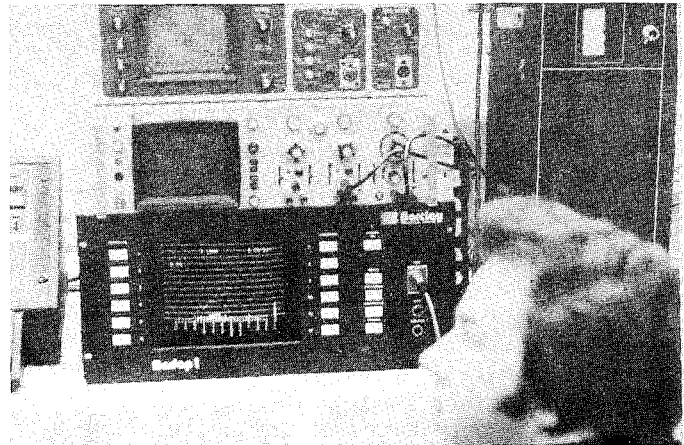
I'm sure all of you can help us expand the list.

CROWN BADAP I

One of the fascinating new tools we are employing in current classes is Crown's Badap I. This multi-color microprocessor based computer-analyzer allows us to examine the relationship between peak and average sound pressure levels at individual 1/3 oct. frequencies as well as for the overall levels.

The ability to choose the color in addition to the choice of bars or dots for the differing parts of the display allows a surprisingly comprehensive view of multi-faceted audio events.

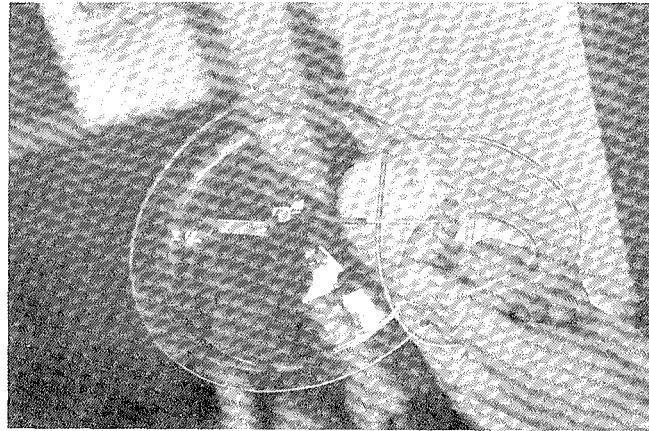
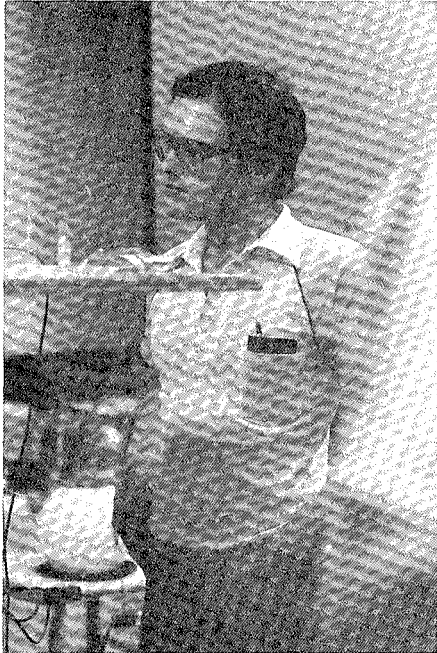
For anyone in the market for a RTA for use in customer demonstrations, the display features of this analyzer wins "hands down."



"BUBBLE" PZM

It's like Christmas when Ken Wahrenbrock arrives at a Syn-Aud-Con class. We know there is going to be an exciting surprise to try out in class. That is how the PZM™ got started. Two years ago Ken arrived in class, with a "here, try this".

The class is looking at a couple of Ken's latest creations: The Pyramid PZM™, the Bubble.



CORRECTION OF A FUNDAMENTAL FLAW

A "sign of the times" is the news release printed in Electronic Industry Weekly, Sept. 1978. We certainly agree with the observations regarding the problems generated by surfaces near the loudspeaker.

Loudspeaker cabinet reflection effects

By JAMES M. KATES
Associate research director
Teledyne Acoustic Research
Norwood, MA

The frequency response of a driver used in a loudspeaker system is influenced by the cabinet in which it is installed. A tweeter, for example, radiates sound waves to the side as well as to the front. The sideward radiation is reflected by the screws used to hold the tweeter in place, the cabinet edge molding, the woofer cone, and any other obstacle or discontinuity on the face of the loudspeaker cabinet.

Two important points emerged from an analysis of cabinet reflection effects. First, reflections combine with the direct sound to produce notches in the loudspeaker system frequency response. The location in frequency of such a notch depends on the distance between the driver and the reflecting surface.

Second, sound waves can be bounced back and forth between reflective surfaces, setting up standing wave resonances on the cabinet face. These resonance peaks depend only on the spacing between the reflective surfaces, regardless of the driver location.

Measurements were made on the tweeter of a two-way loudspeaker system to determine the importance of reflections caused by cabinet edge molding and by the sides of the woofer cone. These measurements show that the cabinet edge molding can cause frequency-response irregularities with a peak-to-valley ratio of 6 dB, accompanied by group delays of up to 0.35 msec.



Kates & AR acoustic blanket

Reflections can be suppressed by either removing the reflective surfaces or preventing sound waves from reaching those surfaces. A "blanket" of sound-absorbent material was designed for a three-way loudspeaker system, and measurements showed that many reflections existed in the system, because the blanket was effective in reducing frequency-response irregularities.

Listening tests were required to find out if suppressing reflections actually makes an audible improvement in the quality of the loudspeaker system. Three observations came

PRINTING HP41C PROGRAMS

We have yet to receive from HP any kind of brochure on the HP 41C and its accessories. We now have the following units in use:

1. HP 41C calculator
2. (4) HP 82106A memory modules
3. HP 82143A printer
4. HP 82104A card reader

And we have on order the new wand.

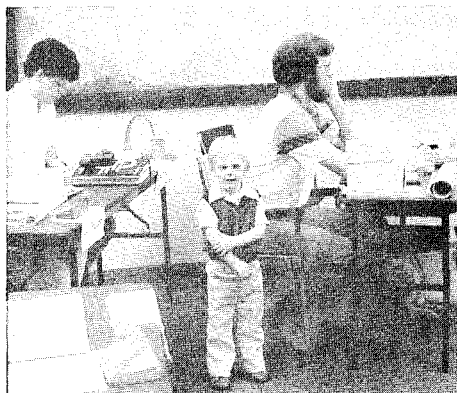
KEN WAHRENBROCK has had four of his memory modules modified so that all four now go into two ports in his HP41C, leaving two ports for peripheral devices. The last issue of the Newsletter we wrote about the PPC Personal Programmer's Club. Ken got the name of the company from their Newsletter. Cost for joining the club is \$15/year. You don't need to be a member to order the memory modification. Cost is \$37.50 for the modification if you are not a member and \$32.50 if you are a member. If you pay \$37.50 as a non-member you receive a \$5 certificate which reduces your membership cost to \$18 for the Club. *(Order info below)

After nearly 6 months using the HP 41C we remain totally satisfied that if you require more capability than these devices provide, you need a large professional computer with color graphics.

There are numerous ways to print out the step-by-step program instructions and the so-called "norm" mode is most useful if you are doing detailed editing work. For the purposes of record keeping, sharing programs and preparing to alter existing programs, the "trace" mode has a great deal to offer. The print-outs shown here are first "norm" mode and then "trace" mode. The saving in space is obvious.

<pre> PRP "GAIN" 01*LBL "GAIN" 02 "INPUT R=?" 03 PROMPT 04 STO 01 05 "SOURCE R=?" 06 PROMPT 07 STO 02 08 "LOAD R=?" 09 PROMPT 10 STO 03 11 "INPUT V=?" 12 PROMPT 13 STO 04 14 "OUTPUT V=?" 15 PROMPT 16 STO 05 17 RCL 05 18 X12 19 .001 20 RCL 03 21 * 22 / 23 LOG 24 10 25 + 26 STO 06 27 RCL 04 28 RCL 02 29 RCL 01 30 + 31 RCL 01 </pre>	<pre> 32 / 33 * 34 STO 07 35 X12 36 .001 37 / 38 RCL 02 39 / 40 LOG 41 10 42 * 43 6.02 44 - 45 STO 08 46 RCL 06 47 X<>Y 48 - 49 STO 09 50 "dB GAIN=" 51 ARCL X 52 AVIEW 53 STOP 54 RCL 07 55 "SOURCE V=" 56 ARCL X 57 AVIEW 58 STOP 59 RCL 06 60 "dBm OUT=" 61 ARCL X 62 AVIEW 63 END </pre>	<pre> PRP "GAIN" 01*LBL "GAIN" "INPUT R=?" PROMPT STO 01 "SOURCE R=?" PROMPT STO 02 "LOAD R=?" PROMPT STO 03 "INPUT V=?" PROMPT STO 04 "OUTPUT V=?" PROMPT STO 05 RCL 05 X12 .001 RCL 03 * / LOG 10 * STO 06 RCL 04 RCL 02 RCL 01 + RCL 01 / * STO 07 X12 .001 / RCL 02 / LOG 10 * 6.02 - STO 08 RCL 06 X<>Y - STO 09 "dB GAIN=" ARCL X AVIEW STOP RCL 07 "SOURCE V=" ARCL X AVIEW STOP RCL 06 "dBm OUT=" ARCL X AVIEW END </pre>
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* Order from: Emmett Ingram #17
 P O Box 2633
 Rolling Hills Estates
 CA 90274



"START'EM YOUNG"

"Start them young" is Syn-Aud-Con's motto. The son of STEVE HUEGLI came in during one of the evening sessions to "sample" the activity.

We like to feel that we appeal to all age groups but it just may have been Judy that was the main attraction.

THE DAVID CLARK COMPANY

We joke a lot in classes and in the Newsletter about "Guilt by Association" such as my picture taken with Klipsch and Heyser, or with Tom Osborne and Jerry Stanley, for example, implying that by close physical proximity some of their "magic" transfers to us.

There is one aspect of the audio business where there is some truth to it. Those of you wishing to be thought of in your market place as the top professional available must of necessity handle the progressive, innovative product lines. The David Clark Company is a Syn-Aud-Con sponsor that fills a niche in a field where most manufacturers produce less than the best.

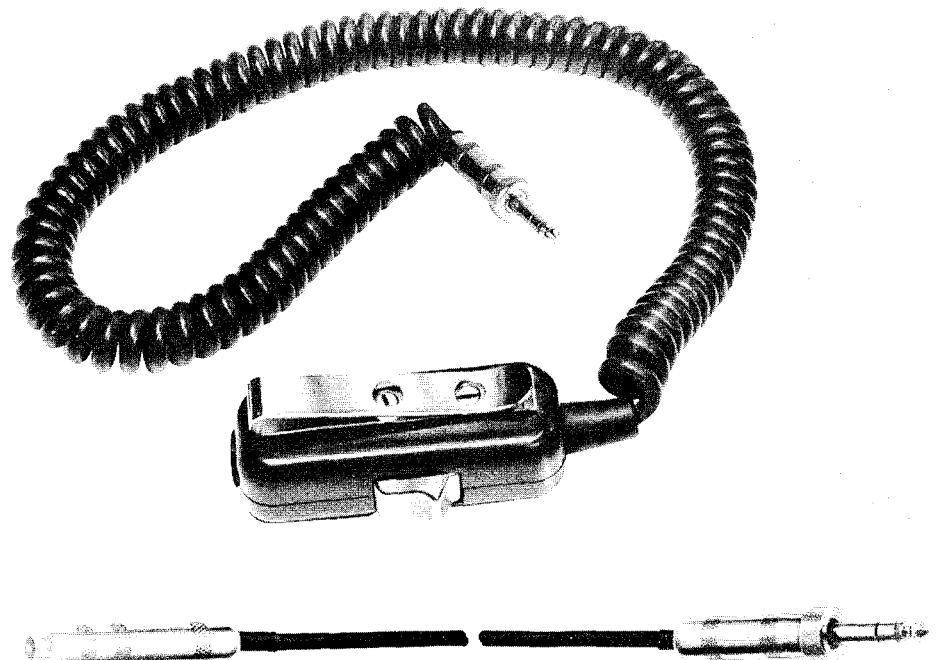
The David Clark Company's inter-communication equipment is truly unique in terms of quality, reliability, and ability to operate in high noise fields. We have used it in sound fields approaching 120 dB with good intelligibility.

The David Clark hearing protectors are so good that we have chosen them for Syn Aud-Con exclusive use with our logo imprinted on them. See Newsletter Vol 7 # 2, page 16.

Another, often invaluable asset is the special accessories they build for their various systems. (Various systems include astronauts space suits, etc.) A recent offering is the C35-15 push-to-talk switch assembly which clips to the belt within easy reach of a user's hands while remaining easy to connect to the headset. The C36 12 extension cord is a twelve foot extension.

The C36 12 extension cord features the same locking connectors, oil resistant cords, and complete shielding to prevent interferences from fluorescent lights, motors and other electrical devices as does the C35 15

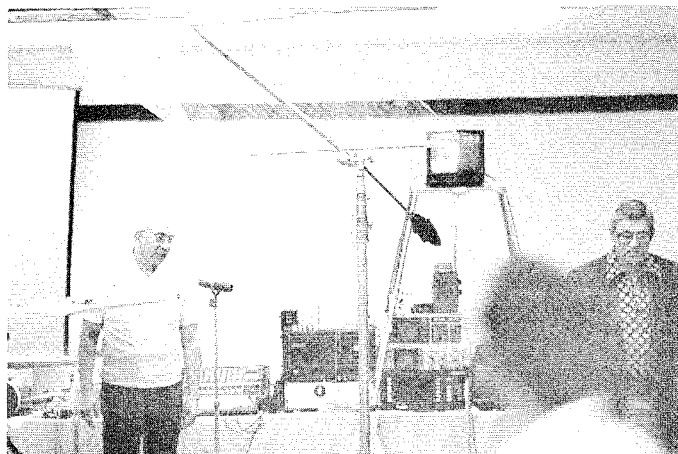
For additional information on the C35-15 push-to-talk switch and the C36-12 extension cord or, for that matter, the entire David Clark line, contact Mr. George Conlon, David Clark Co., 360 Franklin St., Worcester, MA 01604. TL 617-756-6216.



PZM™ ON A BOOM

LEROY SHYNE likes to use PZM's and wanted overhead pickup of groups he was recording. This large plexiglass panel with its associated mounting hardware resulted.

We are told the results are impressive. There's no question that his design is both visually and mechanically overawing.



Leroy Shyne of Shyne Sound in San Rafael

BOOKS OF INTEREST

TED UZZLE has left "the land of the bean and the cod" for the "Lotus Land" of Southern California.

Ted has joined Altec to assist them with his many talents. He has already discovered that books are considered "imports" here in Southern California.

It speaks well of Altec that they have had the wisdom to hire Ted and we await with great interest the first fruits of this union of industry with our Boston prophet.

Ted promises to write for each issue of the Newsletter, starting with this book review.

The Physicists: The History of a Scientific Community in Modern America by Daniel J. Kevles. Knopf, 1977; paperback edition by Vintage, 1979.

We do not have established religion in the United States. One result is an uneven diversity of religious practice; another result is a religious vitality. In the same way, we do not have an established science. One result is an instant respectability for all kinds of pseudo-scientific twaddle. Another result is the drafting of scientific talent at the beginning of both world wars, so the newly-minted PhDs could march up and down with wooden rifles instead of conduct war research. Another result is the holding of science hostage to momentary politics: the popularity of science after Sputnik, or the statement at a 1971 forum on women in physics that male scientists have "brought us to the gigantic brink of environmental ruin."

The central idea of Professor Kevles' book is that another result is vitality and strength, albeit at risk.

The relations of science and the American Congress are always difficult, often richly aromatic. In 1892 Congressman Henry Clay Snodgrass of Tennessee spoke against a national zoo, in this wise: "I do not believe the American people, hundreds and thousands of whom are today without homes, ought to be taxed to afford shelter and erect homes for snakes, raccoons, opossums, bears, and all the creeping and slimy things of the earth." Ought they be taxed to support the Congress?

The spending of tax dollars for science has been enormously controversial from the beginning. The U. S. Geological survey was charged with the straightforward project of mapping the United States. Immediately these Nineteenth-Century Masons and Dixons found themselves in a mess. Western states, hotly contentious over water rights, could not agree which way a river flowed when it crossed a state line, and the Federal surveyors had to arbitrate. When the Atomic Energy Commission was looking for a site for a particle accelerator, some communities scrambled for the honor while others scrambled to avoid it. Senator Jacob Javits argued eloquently for a New York site with these words: "We cannot afford to horse around with a cornfield."

This book has a gallery of fascinating characters, from I.I. Rabi at Los Alamos, who would get off the train at Albuquerque, NM wearing galoshes and carrying an umbrella, to America's first theoretical physicist of world stature, Josiah Willard Gibbs. His book, *Elementary Principles of Statistical Mechanics* challenged Newtonian mechanics and Aristotelian cause-and-effect. Yale increased Gibbs' salary to \$2000 per year -- after Johns Hopkins offered him \$3000. Gibbs avoided traveling and was long dead before Heisenberg and Bohr saw the implications of his work. William James remarked, "Wait till we're dead twenty years. Look at the way they're now treating poor Willard Gibbs, who during his lifetime can hardly have been considered any great shakes at New Haven."

This book tells the story of the growth of American physics from the days of Joseph Henry, when it was hopelessly provincial (Henry declared the surprise was not "that science has made comparatively *little* advance among us, but that... it should have made *so much*."). The barriers came down, sometimes at tragic cost (doughboys died by the thousands from chlorine gas in the trenches of the first World War, and Congress was finally convinced to repeal a stiff import duty on foreign scientific publications). Today thanks largely to the doctrinaire nature of Nazi science, the story of American physics is the story of world physics.

Your reviewer was driven crazy by the inadequate index, but for the more leisurely reader there are compensating delights, among them Kevles' talent for the deft sketch:

Einstein, in his early twenties, an unknown employee of the patent office in Berne, Switzerland, carelessly clothed, dreamy, something of a cafe bohemian, a Jew by birth who had made the universe his church and its laws his theology.

for the witty dialogue:

Albert Einstein: God does not play dice with the universe

Neils Bohr: Stop telling God what to do!

and for the stunningly apt quotation:

Physicists have known sin; and this is a knowledge which they cannot lose. J. Robert Oppenheimer after Hiroshima.

ARTICLES OF INTEREST

The qualities considered necessary to be "a boss" in today's workplace (see box below) and the qualities that "caused the decline" in American productivity have much in common. (See "Business Week" magazine's special issue of June 30, 1980, "The Reindustrialization of America." Here are some quotes from this interesting issue:

"The nonentrepreneurial background of top managers attracts similarly minded people whose outlook is to make the fast buck and not plan for the future," says Friedrich W. Schroeder of H.P.

"The occasional maverick who bucks the system rarely makes it to the top," adds Peter R. Sugges of Temple University.

"Ironically, the change that is needed probably would involve turning the clock back about thirty years. Before the merger craze of the 1960's, corporate leaders were, for the most part, autocratic, entrepreneurial types who were ready to take risks for ideas they felt in their guts would pan out.Edwin H. Land would have grimaced at the idea of doing a discounted cash flow on research for the Polaroid camera."

How fascinating that at long last these short-sighted, bottom line mismanagers who misappropriated the term *professional manager* are having the fruits of their activities exposed in national business magazines.

The audio industry has suffered much from such "managers" and will suffer even more in the future for their day is not yet done. Exposing their ineffectiveness is one thing -- rooting them out is quite another. We highly recommend this issue of "Business Week" as a good beginning at uncovering the fact that managers who know nothing technical about a technical business *cannot* manage that enterprise competently.

In his book, *The Art of Being a Boss*, Robert J. Schoenberg interviewed hundreds of corporate leaders to learn the inside story on how to climb the corporate ladder of success. Here is a series of questions, extracted from reading these interviews, which characterize the CEO's personality traits.

- Do you like to run things?
- Do you like to lead a group?
- Do you have an urge to get the job done?
- Do you like to resolve conflict?
- Do you like to see results?
- Can you take personal abuse when you think you're right?
- Do you like power?
- Can you manipulate people?

Do you want to accomplish a lot in your lifetime?

- Do you enjoy taking risks?
- Do you feel it your duty to take on greater responsibilities?

Do you like the leverage of getting work done through others?

Do you like working with others to reach a goal?

Do you like to help others solve problems?

Do you like to see other people succeed?

Do you like to be Number One?

Do you like autonomy?

If you can answer "Yes" to each of these questions, then you have the basic "stuff" of which bosses are made ■

**Give Yourself
the Boss Test
to Learn If
You Want to
Be One.**

CLASSIFIED

WANTED:

Two non-Altec crossovers (UREI, Mastering Lab, etc.) for the 604E 16Ω. Don C. Creevy, M.D., 151 Lytton Ave, Palo Alto, CA 94301. (415) 851-0140

FOR SALE:

Shure M615AS Equalization Analysis set with mic. New condition. \$300 or best offer. Above name, address and phone number.

EMPLOYMENT OPPORTUNITY:

Audio systems design engineer. Rich Greenalgh, Paramount Sound, 1651 Gardena Ave, Glendale, CA 91404. (213) 956-3222.

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The information conveyed in this Newsletter has been carefully reviewed and believed to be accurate and reliable; however, no responsibility is assumed for inaccuracies in calculations or statements.



**INDUSTRIAL
RESEARCH
PRODUCTS, INC.**
A Knowles COMPANY

SYNERGETIC AUDIO CONCEPTS

EMILAR

CORPORATION

SYN-AUD-CON SPONSORS

Syn-Aud-Con receives tangible support from the audio industry, and ten manufacturing firms presently help underwrite the expense of providing sound engineering seminars. Such support makes it possible to provide the very latest in audio technology while maintaining reasonable prices relative to today's economy, and to provide all the materials and continuing support to all graduates of Syn-Aud-Con.

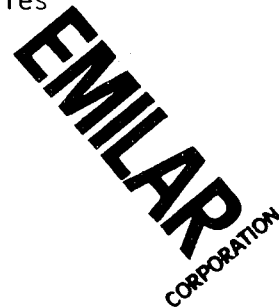
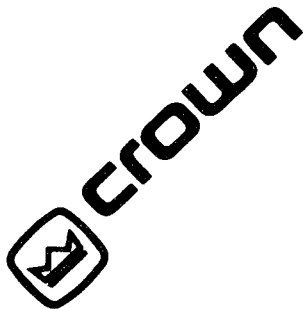
Personnel from these manufacturers receive Syn-Aud-Con training which provides still another link in the communications circuit between the ultimate user and the designer-manufacturer of audio equipment. They are "in-tune" with what a Syn-Aud-Con graduate needs.

Their presence on this list as a Syn-Aud-Con sponsor indicates their desire to work cooperatively with you in professional sound.

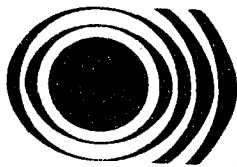
- United Recording Electronics Industries
- GenRad, Inc.
- Shure Brothers, Inc.
- Sunn Musical Equipment Company
- Crown International, Inc.
- Emilar Corporation
- David Clark Co., Inc.
- Rauland-Borg Corporation
- Industrial Research Products, Inc.



UNITED RECORDING ELECTRONICS INDUSTRIES



sunn



DAVID CLARK COMPANY



RAULAND-BORG CORPORATION