SYNERGETIC AUDIO CONCEPTS

newsletter

VOLUME 3, NUMBER 3
April, 1976

P.O. BOX 1134, TUSTIN, CALIFORNIA 92680

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
We exchanged dollars
I still had a dollar

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

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ZURICH '76 -- EUROPEAN AES

We attended the 53rd AES Convention in Zurich. (We were in Europe on a consulting assignment.) The show, while not as large as those in the United States was of high caliber and the exhibits contained displays by many exhibitors who do not show their equipment here. Syn-Aud-Con graduate and consultant, ERNST VOELKER (Los Angeles class 1975) of Frankfurt, Germany gave my paper, "Q, EQ, and ā" in German during the Convention. James Moir, who speaks German and is well equipped to evaluate the paper said that Ernst gave a good paper on Q, summing up much of what I have written on the subject. In fact, Mr. Moir said that Ernst's delivery of my paper was better than the preprint, which says a lot considering that the concepts of sound system design were new to Ernst less than a year ago when he took the class in Los Angeles.

Dick Heyser was present at the AES and from there went to Bruel and Kjaer to consult for them. One can expect to see something along the lines of a Phase Analyzer from B&K in the future. And B&K is planning to produce James Moir's calibrated and adjustable acoustic source. (More on this next Newsletter)

We visited Mr. V. M. A. Peutz and his family at their palatial home in Nijmegen, Holland. Mr. Peutz has a 40 man acoustical consulting firm with over 800 projects in house. As soon as we have had time to assimilate the material that Mr. Peutz so generously gave us, we will share some of it in future Newsletters.

In London we were shown the Royal Festival Hall "Assisted Resonance System" by its developer, Peter Parkin, and its installer, Geoffry Berry of AIRO. We stayed for a concert and we felt that the Assisted Resonance System provided a very definite improvement in the hall and undetectable as an electronic system. In visiting Mr. Berry's firm, AIRO, the caliber of equipment design and technical support available for Assisted Resonance Systems left us with no hesitation in suggesting it for any project where a hall is designed for reverberation time best for speech and through Assisted Resonance the space is made very acceptable for music by doubling the RT. GORDON CROUSE (San Francisco class 1975 and '76) is the AIRO representative in the United States and currently there are two halls in the US which uses Assisted Resonance.

Mr. & Mrs. James Moir were our host for a day. Mr. Moir is famous for his book, *High Quality Sound Reproduction* and for his work in over 200 English motion picture theatres as well as his participation in the four man team that developed British Radar at the start of World War II. Mr. Moir gave us valuable insights into the sound reinforcement industry in England.

Eddie Veale, a well known London studio and acoustical consultant, and his assistant, Heather Wood, took us on a tour to see three of the better known and/or quality recording studios: Trident, AIR, and the Round House. AIR was preparing for the installation of the first Neve *computer controlled console* (the computer *moves* the knobs). Trident and the Round House employed huge (approx. 6 feet high) monitors with dual 18" woofers and high levels at remarkably low distortion. UREI limiters and other signal processing devices were in evidence at all the studios as were Crown amplifiers (called Amcron in England).

In the Kensington Science Museum we saw Babbage's original Difference engine.(Babbage developed in the early 1800's the idea for a giant mechanical computer which is today the philosophical model for our modern computers.)

H.P. TO GIVE 3 PAPERS AT AES

Three papers are scheduled to be given by Hewlett Packard personnel at the May AES Convention in Los Angeles. One paper, *A New Low Cost Real Time Analyzer*!!

SYN-AUD-CON GET TOGETHER AT AES CONVENTION

Syn-Aud-Con will host an informal get-together at the Spring Los Angeles Audio Engineering Society Convention at the Hilton Hotel, Tuesday Evening, May 4. We have decided to hold the get-together the first evening of the Convention so that Syn-Aud-Con graduates can meet and find common interests early in the convention rather than at the end, as we did last year.

Syn-Aud-Con will provide a suite with refreshments and an environment that will allow relaxing conversation between professionals interested in audio. The suite number and the time for our get-together will be posted in our Syn-Aud-Con exhibit booth, #58, at the convention, or you can ask for the Suite for Don Davis at the front desk if you haven't registered for the Convention by Tuesday evening.

The schedule of papers for the up-coming convention looks unusually interesting, especially on Wednesday, Thursday and Friday. Anytime you don't find us in Booth 58 most likely we will be attending technical papers.

If you would like to meet someone at the convention and need an introduction, check with us. Very often we can arrange an introduction.

The AES convention is open to members and non-members ($10 & $15 registration respectively). If you are not a member and want to attend and are from out of town, you will be interested to know that Avis Preferred Convention Delegate Discount Card will allow you to rent an Avis car for $19.95 per day with unlimited mileage - should you want to spend some time during your trip seeing suppliers, etc. (Members received this info from AES)

Hope you can join us.

COURT DECISION OF IMPORTANCE

On December 14, 1974, the Federal 1st Circuit Court affirmed a very important decision handed down by the United States District Court, Mass. in the case of Whitten Corp. vs. Paddock, Inc. The U.S. Supreme Court has rejected further appeal and further review.

Four major judgements regarding specifications develop from this landmark decision:

1. An engineer may limit his specification to one brand only without being in violation of anti-trust law
2. The specifier is the sole judge of what equipment may be accepted as "or equal"
3. Only the specifier may change what equipment is allowed
4. It is up to the supplier to convince the specifier that his equipment is suitable. (He must sell the specifier if he wishes to be included in the specification.)

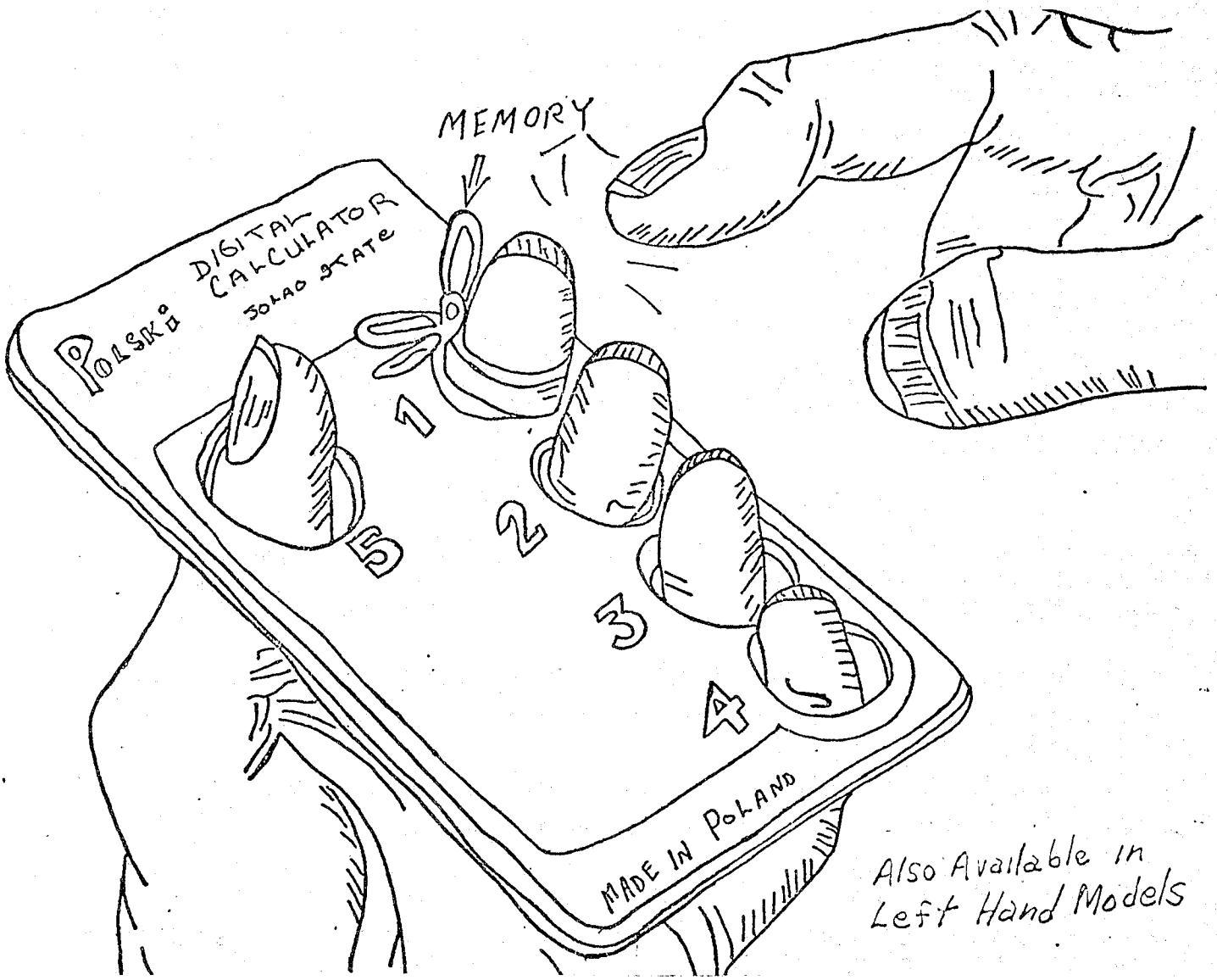
You can write tight specifications without fear of legal actions forcing acceptance of other products. Remember, however, that while the specifier has greater power now he also can be held legally responsible for any specification that turns out badly, or, for example, causes injury, etc.

CALCULATORS

We have 35 of the HP21s for class use now. We bought 10 "demonstrators" from Hewlett Packard for $75 each; and the last 5 from Olympic Sales in Los Angeles for $85 each. Olympic says that 1 HP 21 costs $89. We've seen the HP 25 advertised for $175, and the SR-52 for $299.
Calculators keep coming down and new models are introduced. There is a temptation to wait for the next model or the lower price, but....

FPN

Each class is introduced to the Reverse Polish Notation (RPN) method of calculating used in the HP 21 calculators. MERL NORTH, Hurley Electronics in Las Vegas gave us a sketch of an earlier Forward Polish Notation (FPN) machine. (and when we got home from the LA class, BRUCE THAYER, WMT Music in Cedar Rapids - Chicago class 1974 and '75 - had another copy waiting for us.)



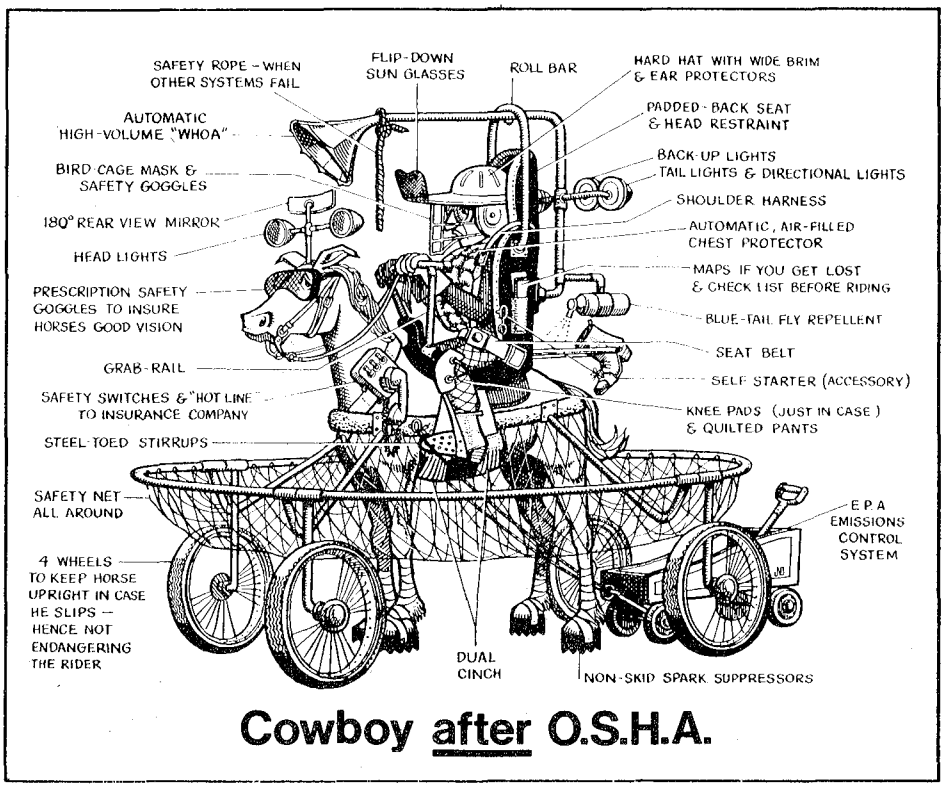
Additional modules (another hand, and two feet) are available to extend the range. Some rare models come with six digits. Users frequently write to Greenwich for the time. As Bruce says, note the exceptional tactile feedback available. A double digit model is available that utilizes the nose for counting (the metric model).

"DON'T RUB IT IN"

In one of the recent classes, when we finished the dB chapter, I said, as I usually do, "We're not covering anything esoteric, we're just covering the basics of our business." To which someone in the class called out, "You don't have to rub it in."

OSHA INSPECTORS NEED A WARRANT?

From the Wall Street Journal: Do safety inspectors have to have a warrant? Some judges say yes. In late 1974, a Plano, Texas, retailer refused to permit federal officials to conduct a routine inspection of a discount store. The Labor Department then asked a federal court to require the inspection, under the 1970 Occupational Safety and Health Act. But a three-judge federal panel in January dismissed the case. The judges found that when employers object, federal safety sleuths can inspect only with a search warrant and after showing there is reason to believe the law has been violated. If it stands, the decision would permit employers "to stop statutory enforcement cold," department attorneys argue. They're preparing to appeal.



J.N. DEVIN IN *NATIONAL SAFETY NEWS*

Mythical supersafe cowboy illustrates what many businessmen think of the practicality of federal health-and-safety rules. Union leaders, however, complain regulation is lax

Reprinted with permission from National Safety News

KEN STOLTENBERG of Electronic Engineering Services, Rochester, MN (Minneapolis class 1973 & 1975) sent in the following interesting news.

WARNING: CHILDREN DO NOT MEET OSHA SPECS

PROVING THE OBVIOUS

Children, it has long been suspected, are dangerous to the health of adults, and British investigators have now documented one way this is true.

Primary schoolchildren were invited to scream into a sound level meter. The mean level of some 200 screeches was 114 dBA. The highest was a 12-year-old girl who logged in at 122 dBA, which, according to *New Scientist* (Volume 68, Number 980) is at the threshold of listener pain. A four-year-old reached 111 dBA.

What is generally considered a safe noise level for extended periods of time is 90 dBA. So now it is proved that children can be a specific occupational hazard for teachers who mind the playground.

METRICATION AND MOTHERHOOD

The Letter to the Editor of *PHYSICS TODAY* (February 1976) reprinted below points out far more clearly than most the futility of forcing conversion to the antiquated metric system. The very calculators which are re-making our world of thought around us talk binary, not decimal languages. I personally believe that it is important that we not swallow the metric system. Our real need is for a better system.

Metrication and Motherhood

It has frequently been assumed that scientists unequivocally support a legislated metric conversion. However, 22 faculty members in our department representing 40% of those contacted signed the following petition:

"Many now believe that eventual acceptance of the International System of Units (the proposed standardized metric system) is "inevitable." *If* this is true, then we believe that the "inevitable" conversion should take place naturally *without* the prodding of the ten-year program now being considered by the Congress.

"As scientists, we are well aware that the International System of Units is but a step in the evolving relationship of man to nature. Its origins are in the metric system, originally formulated during the French Revolution. The framers of that system could not foresee the impact which subsequent developments would have on technology. Units for developing sciences like electricity or optics were first introduced *ad hoc*. By the early part of this century, the metric system itself had been enlarged to encompass these 19th century developments. With little further modification, this enlarged system has become the International System of Units.

"Although recognized by statute the world over, the International System has not been fully accepted—even by European scientists and engineers. Deprecated units for such common concepts as force, pressure, and magnetic field persist because they are more convenient than their counterparts in the International System. More importantly, as a crystallization of basically 19th century technology, this system is poorly suited to 20th century developments. These developments have been in our understanding of fundamental atomic and molecular processes and in the use of binary—rather than decimal—arithmetic in computers.

"Within a generation, man may well devise a truly modern system—one which combines the coherence of the International System with the convenience of our customary one. We are concerned lest a legislated conversion to a rigid system deprive future generations of the benefits of a truly optimal system of measurement.

"Therefore, be it resolved that we, the undersigned members of the faculty of the Department of Physics and Astrophysics at the University of Colorado, urge the rejection of pending metric conversion legislation."

While circulating the petition among our colleagues, we discussed the broader problems of metrication. Some felt that a generation was far too long for an optimal measurement system to crystallize. The elements for such a system exist now. PHYSICS TODAY could help by publishing some of the many letters it has received that urge alternatives to the metric system.

Even if an optimal measurement system is an idealistic goal, many faculty felt that the metric system itself is not sufficiently meritorious to warrant Congressional interference in the conversion that is now slowly taking place. The economic costs of conversion may be minimized by letting the marketplace rather than a national plan determine the timetable.[1]

More importantly, the social cost of conversion would be lessened if each sector converted only when pushed by "popular demand." Not until the majority want it should the weatherman accost his listeners with a sultry 32 degrees Celsius or a few millimeters of rain. Why should the present adult population be forced to adjust to new measures? School children today, however, are being taught metric units and, when adults, they should be amenable to change. The alternative—conversion by plan—is bound to be viewed by adult citizens generally as an attempt by an elitist group of scientists and engineers to force the issue.

Reference

1. Letter of the Comptroller General to Hon. H. R. Gross and reply of the Director of National Bureau of Standards, "Conversion to the Metric System of Weights and Measures," Hearings before the House Subcommittee on Science, Research and Development, March–May, 1973 (pages 390–410).

DAVID F. BARTLETT
CHRIS D. ZAFIRATOS
University of Colorado
Boulder, Colorado

CROWN INTERNATIONAL IS A NEW SYN-AUD-CON SPONSOR

Crown International has joined the Syn-Aud-Con family of Sponsors and we are looking forward to meeting and working with their key personnel in engineering and marketing. We will be visiting their Indiana plant during the summer months and will have Crown people in our Chicago and perhaps our Columbus class, and we will share product ideas and applications in our Newsletter.

In the meantime, those graduates already using Crown products and who have shared their experiences with us will be pleased to know that Crown has undertaken sponsorship. To those who haven't tried the Crown DC300A we would like to point out that it is a *stable* high powered, high quality amplifier most suitable for commercial sound work.

DAVID CLARK CO.

In the Los Angeles class we had the luxury of using David Clark (our new sponsor) headsets and noise cancelling microphones during the microphone testing session. These units allow us to be directly in front of the loudspeaker while it is putting out 100 dB-SPL of random noise and converse in normal tones. The headset part of the units is a complete hearing protector plus headset. And we used a remote headset so members of the class could listen in.

We'll be writing a good deal more on the David Clark system of intercommunication as we believe it to be much superior to the other systems that have been suggested to us as suitable for entertainment work.

MASON INDUSTRIES

Mason Industries, Inc. is an outstanding source of vibration control devices. They excel in advising potential users of their equipment and optimum application techniques.

They offer vibration isolators for applications as diverse as suspending a loudspeaker from a structure (with isolators available that include earthquake shock snubbers) to the isolation of entire rooms, if needed.

For those Syn-Aud-Con graduates needing vibration isolation devices, Mr. Mason has offered to send their very complete catalog to you upon a request from you on your letterhead. Mason Industries, Inc. 92-10 182nd Place Hollis, New York 11423

PHIL CLARK'S NOMA USED IN ALASKA

DAVE FAHRNEY of Audio Communications in Anchorage, Alaska (LA class 1975 and Seattle '76) and owner KEN FLANIGAN (Seattle 1976) have designed, installed and report extremely successful operation of a city council chamber with 20 open microphones. How? They used Shure's Voicegate units plus Phil Clark's Number-of-Open-Microphones-Attenuator (Newsletter Vol. 3, No. 2)

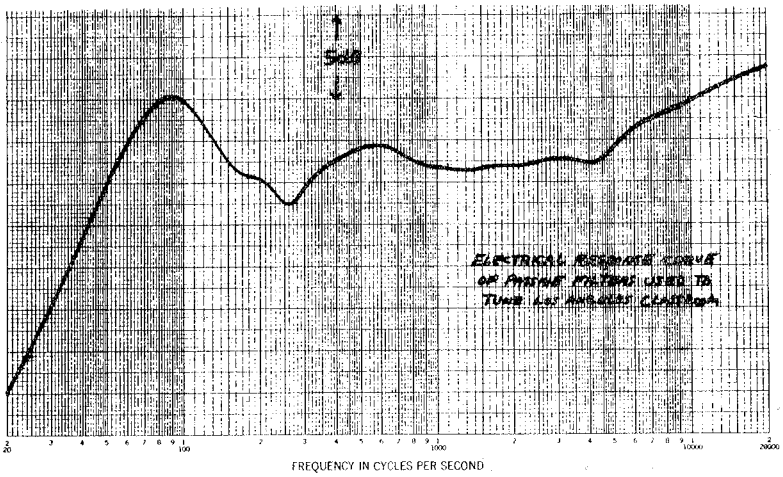
They caution that you need to give Phil Clark 30-60 days to produce any NOMA adapter that you order and that it is well worth the wait. (Diversified Concepts, Inc., 3920 New Seneca Turnpike, Marcellus, New York 13108

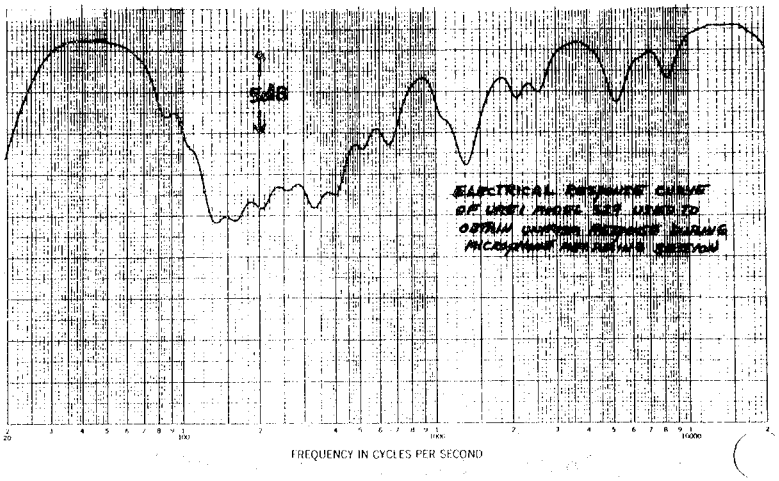
MORE DATA ON THE UREI MODEL 200 RESPONSE PLOTTING SYSTEM

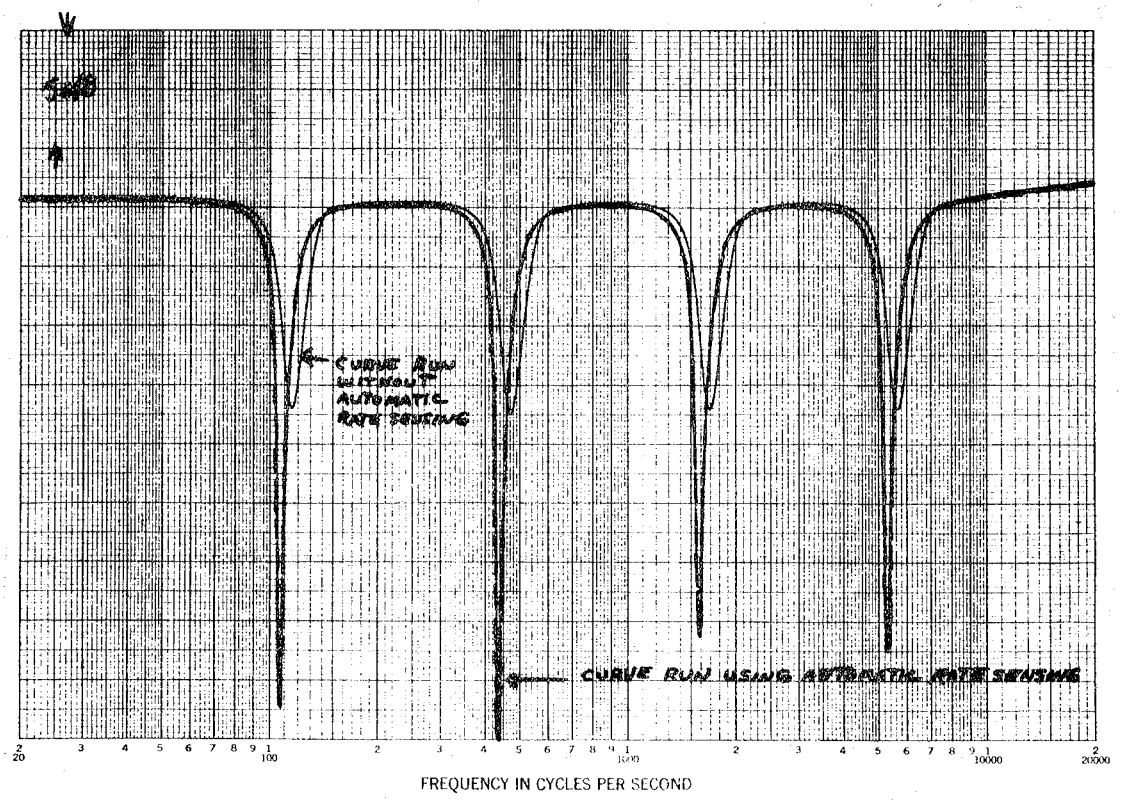
During the Los Angeles class March 23-25 we had the opportunity to test the UREI Model 200 Response Plotting System with the Model 2000 plug-in module (sine wave response).

The following response curves are indicative of the extreme precision possible to achieve in the measurement of filters, etc. The response curve of the UREI 560 filters shows clearly the benefit of the automatic rate sensing control when measuring narrow band filters with steep skirts. Without this (patent applied for) control you would have to adopt a very slow paper speed in order to avoid inaccuracies. With this unique control the pen travels across the paper at *exactly* the correct speed to match the slope it is tracing.

The Model 200 is: smaller, lighter weight, more accurate, easier to use, much lower cost (less than $2300), more rugged, and it uses conventional chart paper.







UPRIGHT AIR-LIFT

In the January 1976 Newsletter ANDY SOBIERALSKI sent in information about Up-Right Rota-Locks along with pictures showing an application in sound system installation, and we included a brochure from Up-Right Scaffolds. (SHAWN MURPHY, in our special Disneyland class in January - as well as two previous classes - mentioned that Rota-Locks are used heavily in stage lighting and that it is *important* to follow correct pipe size for proper clamping.

Up-Right sent us a news item on their Air-Lift used by Led Zeppelin: (undated release)

"Presenting any concert is a challenge. For one like the Led Zeppelin, held recently in San Diego, lights, speakers, and special effect devices by the ton heighten the requirement. Air-Lift telescoping portable work platform can make the job easier. Powered by self-contained CO_2 tanks, it lifts the worker effortlessly to working heights of 42' in minutes. The non-conductive fiberglass platform, with built-in safety rails and toeboards, meet or exceed OSHA requirements.

"The Air-Lift is manufactured and sold by Up-Right Scaffolds, 1013 Pardee St., Berkeley, CA (415)843-0770."

"FLYING" THE SOUND SYSTEM

We are hearing more and more that entertainers are "flying" the array: The recent WHO tour; STEVE JAMES of Nevada Audio Visual said that Elton John flew the sound system for his recent concerts in Las Vegas; and JIM COE, DON PEARSON and HOWARD DANCHIK, sound men for the Jefferson Starship Group, were in the San Francisco class this year. They said that they were "flying" the sound system now and that they had hired "Jack, the Rigger" from Philadelphia to go ahead of them at each concert to rig the system.

Whether the sound system is flown because it sounds better, or it frees up valuable high-paying seats, or the rule has come down from on high that concert goers cannot be subjected to the high SPLs that comes from sitting directly in front of the array on the stage (The Minnesota State Fair committee put a limit on the distance from loudspeakers to audience.) -- whatever the reason, it does sound better. Less than three years ago we were told by sound men for the entertainers that the concept would "never fly".

LARGEST ONE NIGHT RENTAL?

BRUCE WARDIN of Bruce's World of Sound in Phoenix told us about his sound system rental for Richard Nixon shortly before he resigned the presidency. The rental was $9,760., which is the highest one-night rental of a sound system we have heard of. Shortly after talking to Bruce about the rental, ORRIN JOHNSON and DAVE LEWIS from Phoenix were in our Philadelphia class and had attended the "rally" where Bruce had provided the sound and confirmed that it was outstanding sound reinforcement. Our next class was in D.C., and ROBERT STUPEC was in the class. When we mentioned Bruce's rental, Bob said that he was with the White House Communications at that time (now with Robert Slye Co.) and was involved in the authorization of the rental from Bruce.

Many of us could take lessons from Bruce's World of Sound when it comes to selling high quality, high priced sound systems. BWOS has been active in the Disco market for well over 4 years. Price of the total systems is approximately $18,000 plus installation expenses. Six hour service is guaranteed with the customer paying the expenses. Much of the equipment is designed or modified by BWOS. Their Disco system are all over the United States.

Bruce's World of Sound has been a strong supporter of Syn-Aud-Con training, having put 6 men through, starting with the very first Syn-Aud-Con class in Los Angeles.

BUBBLE MEMORIES

According to Paul V. Michaelis of the Bell Laboratories, 1976 will see the use of bubble memories in actual products. Hewlett Packard is believed to be planning a new desk calculator with bubble memory as a substitute for disk memory.

Bell Labs prototype unit has a capacity of 500,000 bits and can be scaled up to 1,000,000 bits. They feel the device could replace fixed head rotating-drum and disk memories within two years.

IBM reports bubbles as small as one micron. In IBM's amorphous-film approach, bubbles can be moved from one circuit element to another by alternating the polarity of each element through rotating the external magnetic field.

What this means to audio engineers is:

1. Much lower cost, much higher capacity calculators are just around the corner
2. Simple computers for automated control of audio processes will be small enough in memory to be placed physically in recording consoles and handle not only levels but equalization with memory left over.

MORE FROM CECIL CABLE AND DAVE KLEPPER ON Q

CECIL CABLE AND DAVE KLEPPER have been looking at Q from slightly different angles with the result that we all may share new insights into what Q really is and how we might take better advantage of any natural enhancements available through design, placement, room treatment or combinations of the above or of as yet unknown modifiers. We have to ask, "Is it Q that needs to be large or is it D_C in order to obtain our goal?"

Cecil Cable writes: (Los Angeles class 1973 & '74; Canada 1976)

The philosophy which follows is my own, intended not to oppose or refuse the opinions of others, but to explore and perhaps shed some light down the pathways of the study of "direct", "early" and "reverberant" sound within rooms.

To the question "Is there a practical limit on directivity?" I would say "Very definitely."

What is the Q of a line source at ceiling line, running the full length of one wall of a plane rectangular reverberant room? If the line is considered a segment of an infinite line, horizontal radiation is monodirectional, normal to the line. No sound impinges upon the sidewalls of the room, which at this point in the discussion has no significance.

The line source at the "junction of wall and ceiling line" has radiation confined to a vertical angle of 90^o so if we use the term loosely we might say our source has a vertical Q of 4.

Now what is the "horizontal Q" of our line source? At this point in the discussion the room dimensions and listener positions have not been qualified. If the room is "large", and auditor position is such that first order relections from the floor and rear wall are "late", these reflections may not be integrated with the "direct sound" so do not enhance "Q" - so let us remove the floor and rear wall. We now effectively have our source in free space with vertical radiation of 90^o and monodirectional horizontal radiation with source length X. This provides us with a radiation pattern which might be likened to 1/4 of a solid cylinder where vertical radiation is $\frac{\pi}{2}$ radians and horizontal radiation remains a constant length X (equal to room width).

Now, by definition, our auditor target is $\frac{\pi}{2}$ radians x X, here radians may be defined by being equal to r, the auditor distance from the source. It is obvious that our target area becomes a function of r.

Q may be defined as the ratio of the imaginary sphere surface area of $4\pi r^2$ to the area of the projection of the auditor area "patch" (the target area at distance r) on the surface of the imaginary sphere, expressed in radians. (EDITOR'S NOTE: This is not the recognized definition. See page 39 of *Sound System Engineering* for the definition by Arnold Peterson and Ervin Gross.)

The area of the imaginary sphere is a function of r^2. The area of the "patch" is a function of r x X where X is a constant. Q is a function of

$$\frac{4\pi r^2}{\frac{\pi r X}{2}} = \frac{8r}{X}$$ and Q approaches infinity only when r approaches infinity.

When r is small (as in real rooms) Q becomes small, equal to 4 when 4 = 1/2 X.

Reinstatement of the rear room wall and the floor cannot do anything to alter radiator Q which is a function of geometry. First order early reflections may integrate with direct sound to extend D_C to a given auditor. This effect is finite and of low order.

Notwithstanding a line source and reflective boundaries, no magical powers can be endowed upon the configuration to provide exceptionally high Q's to the target auditor area.

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Cecil Cable, continued

A given auditor may be provided with sound from a high Q radiator by concentrating the direct radiation from the source to this auditor. But if another auditor in the target area requires equal consideration, our given auditor must share power to the second listener. The Q to each auditor is now 1/2 of the maximum Q to one auditor alone. If many listeners are to be served in a given auditor area, an absolute maximum Q obtainable to provide each auditor with his "fair share" of direct sound is determined by geometry. The most simple case, a central source array over a plane circular auditor area is fully developed and defined for polar co-ordinates in "The Qualification of Loudspeaker Directivity Factor in Sound Reinforcement System Design." (Journal of the AES, Vol.23, No. 6) The unpublished work of Curtis Emerson opens the door to similarly defining maximum possible Q's attainable in most rectangular spaces one is likely to encounter in design work.

To the question: "What is the Q of a segment of an infinite plane source (radiation uniform, monodirectional and normal to the plane)?" I would again reference my previous work JAES July/Aug. Vol. 23, No. 6, "Coverage of a Given Plane with Radiation Normal to the Plane." The question implies that radiation is indeed, uniform, monodirectional and normal to the plane. If this is true, no direct sound impinges upon the side walls, floor or ceiling, so the prime radiation is not affected by these boundaries.

The free space solution solves for a quasi Q which is valid for a derived D_C when boundaries are placed around the plane source. Again, early reflections from the boundaries may extend D_C but the quasi Q is a function of geometry.

The foregoing is submitted as an excursion into the unknown. The equation $\frac{8r}{X}$ may be open to suspect. I have not subjected it to a rigorous proof, but believe in a general way it supports the philosophy.

DAVE KLEPPER ANSWERS:(New York class 1975)

I have considerable respect for Cecil Cable, and my comments on his comments are intended to present another way of looking at the problems of directivity; they are not in any way intended as a "refutation".

Cecil first says that there is a practical limit on directivity. If so, just what is it? Consider, what is the directivity of a loudspeaker in a plane-wave tube? Pretty near infinite, I would say! And a real architectural version of a plane-wave tube, with an area-array source and a sound-absorbing (audience+carpet+upholstered chairs) termination should be possible.

I will agree with Cecil that the line source located at the junction of the wall and ceiling has a "vertical Q" of 4. With regard to the horizontal Q, I mentioned the side walls, because they force the finite line source to behave like an infinite line source. Of course, at high frequencies no significant amount of sound energy is reflected off the side walls, but at low frequencies, where the wavelength might approach the order of magnitude of the length of the line, then the side walls, perpendicular to the line, effectively extend the line to infinity.

I would also point out that an observer near the floor (normal ear height) hears reflections off the floor as useful, not "late" reflections, and an observer near both the floor and the rear wall, hears reflections off of both surfaces as useful reflections.

The remainder of Cecil's comments concern an effective Q, as modified by target absorption considerations, and this leads to the development of the "quasi Q" mentioned in his JAES paper. There may well be a very real limitation on this "quasi Q" for a specific audience size and loudspeaker distance. I confess I was more concerned with the classical, unmodified "Q", where the integration of both the target area and the remaining area are done in the far field, over a sphere with sufficient

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Dave Klepper, continued

radius so that the area source or line source looks like a point source except for its directivity.

Turning to our scaled-up architectural version of a plane-wave tube, it may have a long reverberation time when excited by an omnidirectional sound source located in its center, but close-to-zero reverberation time would be measured if it were excited by the plane source at one end, assuming absorption at the other end. In a classical sense, the system would have near infinite directivity, although Cecil's "quasi Q" would have a lower value because of the finite target area.

STUFFING MULTICELLS

JOHN BURGOYNE, Triton International, Manila, Philippines (Chicago class 1973) sent in interesting data on stuffing multicells:

We stacked three EV M253 Multicellular Horns (2x5) in a column array and hung them about 2.5 meters from the floor on one of the horizontal members of the scaffolding. All three horns had EV 1828T Driver Units connected in parallel at their 30 watt taps. There were driven by a 100 watt amplifier. Filtered Pink Noise drove the amplifiers and consequently, the three horns at approximately 40 to 50 VAC. The reference distance was 5 meters and the far distance was 40 meters. This is how the picture looks:

ARCHITECTURAL DATA:

Location:	St. Andrew Church Paranaque, Rizal	Volume: Surface Area:	11,673 m^3 3,741 m^3

ACOUSTICAL PARAMETERS:

1,000 Hz:	RT_{60} - 7.26 seconds	Ave. $\bar{a}$ - 0.0668	R - 268.01 m^2
2,000 Hz:	RT_{60} - 7.88 seconds	Ave. $\bar{a}$ - 0.0617	R - 246.24 m^2

The first set of tests were made to determine the actual Q of the column with respect to the parmeters of the church. The results are as follows:

FREQUENCY	5 Meters	40 Meters	Q	DI
1,000 Hz	110.5 dB-SPL	106 dB-SPL	13.21	11.20 dB
2,000 Hz	107. dB-SPL	103 dB-SPL	12.83	11.08 dB

For the next set of tests, we stuffed the outer cells of the three horns with poly-urethane foam wedges. The resultant was a 2x3 horn. We arrived at the following data:

FREQUENCY	5 Meters	40 Meters	Q	DI
1,000 Hz	111 dB-SPL	104.5 dB-SPL	20.96	13.21 dB
2,000 Hz	108 dB-SPL	102.5 dB-SPL	22.81	13.58 dB

LEARNING

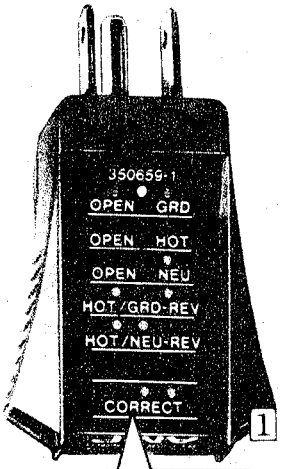
GARY WALLESEN, Design Specialist of Aatronics in Boise, Idaho (Seattle class 1976) sent in a beautiful quote regarding learning, which he said our training concept reminded him of.

"If you want to know how to do a thing you must first have a complete desire to do that thing, then go to kindred spirits - others who have wanted to do that thing - and study their ways and means, learn from their successes and failures and add your quota. Thus you may acquire from the experience of the race, and with this technical knowledge you may go forward, expressing through the play of forms the music that is in you and which is very personal to you."

PLUG-IN ANALYZER FOR GROUNDED RECEPTACLES

SYD STEGALL, Pro Audio/Atlanta (3 time Atlanta graduate) sent in the following:

I am enclosing information about a handy device that we have used for some time now. It's very cheap, can be carried in your pocket and can be purchased at your local Sears. The enclosed clipping is from Sears "Power and Hand Tool Catalogue 1975/1976



Just match pattern of lights to coded key to quickly identify trouble

Plug-in Analyzer for grounded Receptacles

$3.95

Lights up to confirm correct wiring . . or spot trouble

1 So simple to use . . plug into any 3-wire, 115-v. outlet . . or use adapter (not incl.) to plug into 2-wire outlets. One or more lights will come on. Match this pattern of lit and unlit lights with coded key on tester to identify circuit condition. Tests for these 5 errors: open ground; open hot; open neutral; hot and ground reversed; hot and neutral reversed. Also indicates correct wiring. Key appears on both sides of analyzer . . no need to unplug to read. 1½x2½ in. long. Plastic.
34HT6088–Shpg. wt. 2 oz. **$3.95**

THE TEMPERED SCALE

Our Los Angeles class had a number of well informed musicians attending. One of them, JOHN FREITAG, Audio Labs, Cardondale, Colorado, derived the 12 steps on a piano keyboard representing the 12 semi-tone intervals contained in one octave of the tempered scale:

The equal tempered musical scale is composed of 12 equally spaced intervals separated by a factor of $\sqrt[12]{2}$. All notes on the musical scale (excluding sharps and flats) however, are not equally spaced. This is because there are two ½ step intervals on the scale: that between E and F, and that between B and C.

The 12 tones, therefore, go as follows: $C^{C\#}{}_{D}{}^{D\#}{}_{EF}{}^{F\#}{}_{G}{}^{G\#}{}_{A}{}^{A\#}{}_{BC}$

Table 4 The Tempered Scale

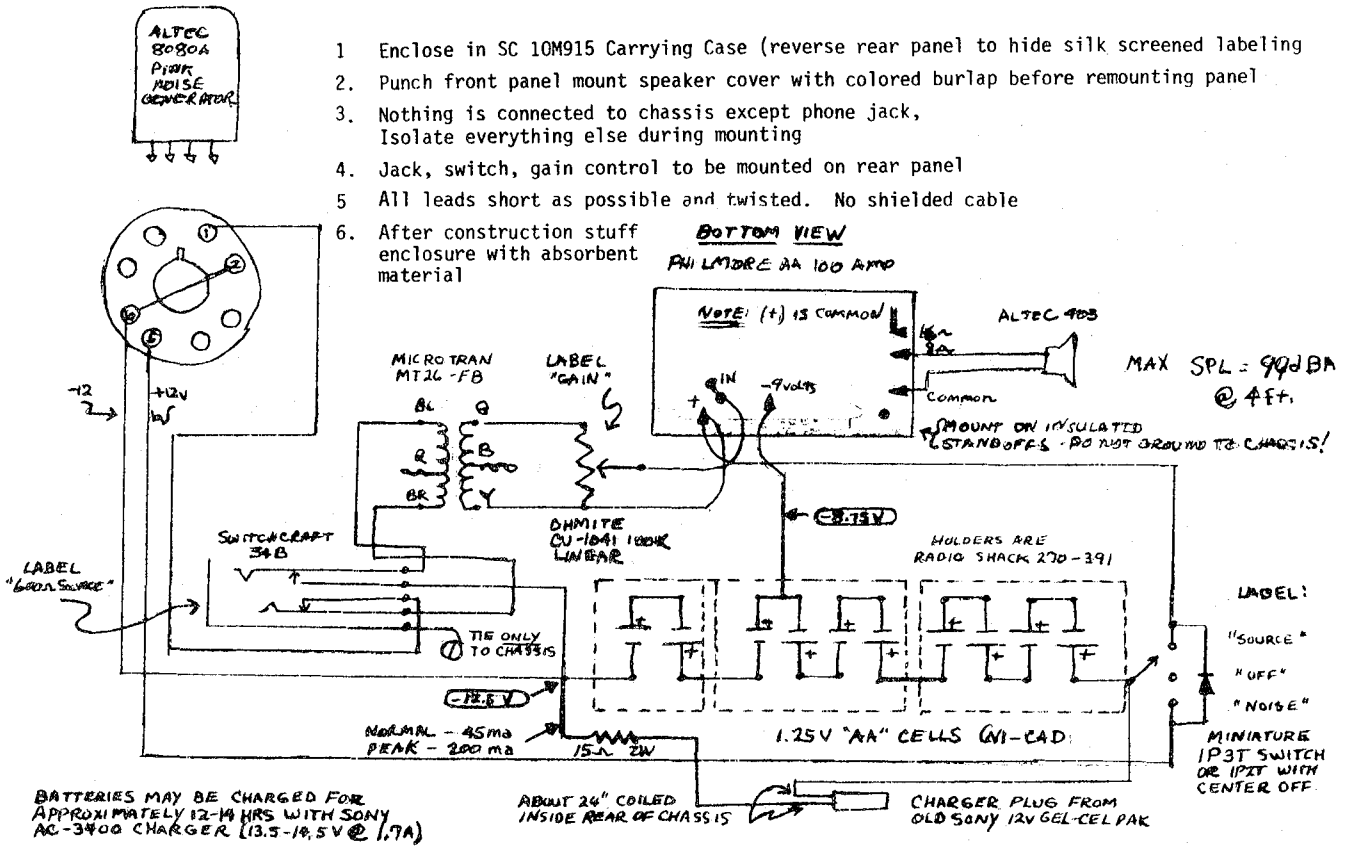
Note	Frequency Ratio	Frequency (Hz)
C	1.000	262
C♯, D♭	1.059	277
D	1.122	294
D♯, E♭	1.189	311
E	1.260	330
F	1.335	349
F♯, G♭	1.414	370
G	1.498	392
G♯, A♭	1.587	415
A	1.682	440
A♯, B♭	1.782	466
B	1.888	494
C′	2.000	523

And, the same material in chart form from *OUR ACOUSTIC ENVIRONMENT* (See Book Reviews)

ACOUSTIC GAIN TEST SET

From KEN O'TOOLE, Audio-Video Corp., Delmar, New York (Boston class 1975):

"Everyone talks about them! Everyone uses them! Everyone needs one - but where do they come from? They can't be bought - so what do you do - You build one - so we did. Here's our AGTS-1, 'acoustic gain test set'. Nothing special but it works well - designed by our Bob Brown. We used NI-CAD batteries and charge them overnight with a Sony AC-3400 charger - (every dealer has one of those around somewhere). We also added a 600 ohm source input so we can use it as a monitor speaker or intercom. The case we used is from a Setchell-Carlson video monitor. We rack mounted the monitor. It has a carrying handle on the rear also. The case is metal and takes a lot of abuse. Bud makes a line of instrument cases 'the show case' line, which would work well. The whole thing, without the case and speaker, costs about $20."



INFINITE LINE ARRAY

KEN PATTERSON, Soundplex Corp in Kansas City (1973 & '75 classes) sent in the attached experimental data. (One of the reasons for the failure of the array to approximate the -3 dB per doubling rate with increasing distance in the near field is the fact that the test frequencies, 2KHz, wavelength does not effectively relate to the wavelength of the array. Ken's subjective response to this array on music tells a great deal about such arrays for use in music systems *provided* that their efficiency is suitable for the particular situation--choice of acoustic environment, type of music, maximum D_2, etc.)

After reading Dave Klepper's and Cecil Cable's ideas in the January 1976 Newsletter, I felt that possibly some light could be shed by setting up an array in my back yard. Ten custom sound columns with each column containing five Soundolier FC104 four inch speakers (with frame to frame driver spacing) were lined up on 30" high tables. The total length of the fifty driver array was 25'. With an outdoor temperature of 20 degrees, not too many measurements were feasible. Anyway, this is what we found measuring 2/3 octave pink noise at 2KC.

1. Maximum SPL occurred at 3 feet
2. From a distance of 3 feet to 10 feet the SPL declined linearly to -10 dB (re 3 feet)
3. From 10 feet to 40 feet there was a *linear increase in SPL*. The SPL at 40 feet was -3 dB (re 3 feet)
4. From 40 feet to 80 feet, the SPL followed the 6 dB attenuation per doubling of distance
5. The gain of the array (one column against ten with the same power applied) at 80 feet was 10 dB
6. There were major frontal lobes of over 6 dB at each end of the array. These lobes virtually disappeared within 5 feet past the ends of the array.

Listening to some Neil Diamond and Mac Davis records:

1. The little speakers combined well on the low frequency end and actually generated some pretty respectable levels in the 50 and 60 Hz region. This was probably due to the length of the array being equal to the wavelength of approx. 45 Hz.
2. The sound was dazzling. This was probably due to the low distortion figure associated with short cone excursions. Now I know whata terrestrial insect gets to hear when it is inside a loudspeaker. Walking around our back yard in the near field of a speaker is a wild experience.
3. Subjectively, a distance or spot could not be found (including the 10 foot -10 dB trough region) where the sound of the vocals was confusing. In fact the cymbals at 80 feet were very nice.
4. The cancellations off the ends and at the rear of the array were so complete, it seemed like the sound was coming from a distant location.

Present theories and thoughts:

1. The 3 dB attentuation per doubling of distance in the near field of a long line array is not valid
2. The Q of a long line array will exceed 200
3. The end lobes would be further accentuated by extending an array to the end boundary surfaces in an enclosure. In fact, if we were to extend the line

more

Ken Patterson, continued

beyond the first row of pews to the procenium opening in a church, we would probably lose about 10 dB of PAG.

4. Under ideal conditions an infinite line array properly positioned relative to four sides of a rectangular enclosure may not be projecting sound, but in reality we may be coupling a long driver to a very large horn. In such a case, the reinforcement might approach face to face communications because the talker and the listeners are all located inside the loudspeaker. Under these conditions the reverberation period would probably be meaningless. I think Dave Klepper's theories along this line are going to prove out.

5. If an infinite line array was placed in the ridge line of a 60 degree "A" frame church, the room geometry would force the Q to be the same at all frequencies.

I would like to hear from others via the Newsletter who have thoughts on the subject or who have actually performed some experiments.

"PREFERRED HOUSE CURVE"

SAM BRIDGES, 3-time graduate (1973, '74 & '75) of Electronic Design Company, St. Paul, has studied the problem of the ideal house curve in some detail and presents more on the subject. (See Newsletter Vol. 2, #2) Do you agree or disagree, and if so, why? You will recall that in class we say "use your ears". When you find the operative parameter, then we can use the "gears between the ears" for better planning at the drawing board stage.

Dear Don:

In a paper given at the 39th AES Convention, October 1970, Allison and Berkovitz stated, "Thus, the single most important factor in assessing the 'frequency response' of a loudspeaker system is the integrated output at all angles." and, "We are convinced that home music listeners perceive the spectral balance of the sum of direct and reverberant fields,..." Since even the house listener rarely sits within critical distance, the direct field would then contribute little.

If this premise is correct, we should be equalizing the reverberant field flat. Further, we should perceive no loss of frequency response if the speaker system is pointed away from us. Yet we know the sound is much too bright in the first case and loss of high frequency response is immediately apparent in the second.

I submit that the "Preferred House Curve" is a generalized method of tuning for flat direct field response. Schulein's work, JAES Apr./75, is certainly not in conflict. I wish he had measured the direct field response of the house speakers. I'll bet he would have found direct field response essentially flat.

To illustrate the point, I have taken two speaker systems and compared their direct field response after equalization to the Preferred House Curve. The assumption is made that both systems had flat direct field response prior to equalizing.

Note that the low Q (#1) system ends up fairly flat all told. If this system had been used in the Schulein tests, he would have confirmed the Preferred House Curve. System #2 has moderately high Q and yields a distorted direct field response. I believe it would be judged too bright by the average listener. If it suffered more from increasing Q with rising frequency, the direct field highs would be further boosted.

Effect on direct sound field of equalizing to "Preferred House Curve" using low Q and moderate Q speaker systems.

Example Room	500	1000	2000	4000	8000 Hz
Room Constant	4900	5444	8167	12,250	16,333
Reverberant Field	30.84	31.29	33	34.76	35.97
Attenuation, Q = 1					
Diff*	0	.45	2.16	3.92	5.13
Speaker # 1					
Q	2	2.4	3	4	4.75
Atten. D**	30.8	31.23	32.89	34.46	35.49
Diff*	0	.43	2.09	3.66	4.69
PWL***	0	2	2.5	4	4.5
Speaker # 2					
Q	7.1	15.3	24	18.3	19.2
Atten. D**	30.59	30.67	31.67	33.26	34
Diff*	0	.08	1.08	2.67	3.41

* The difference is using 500Hz as a "0" reference
** At 100'. Don't have Delta on the typewriter
*** Using 500Hz as "0" reference

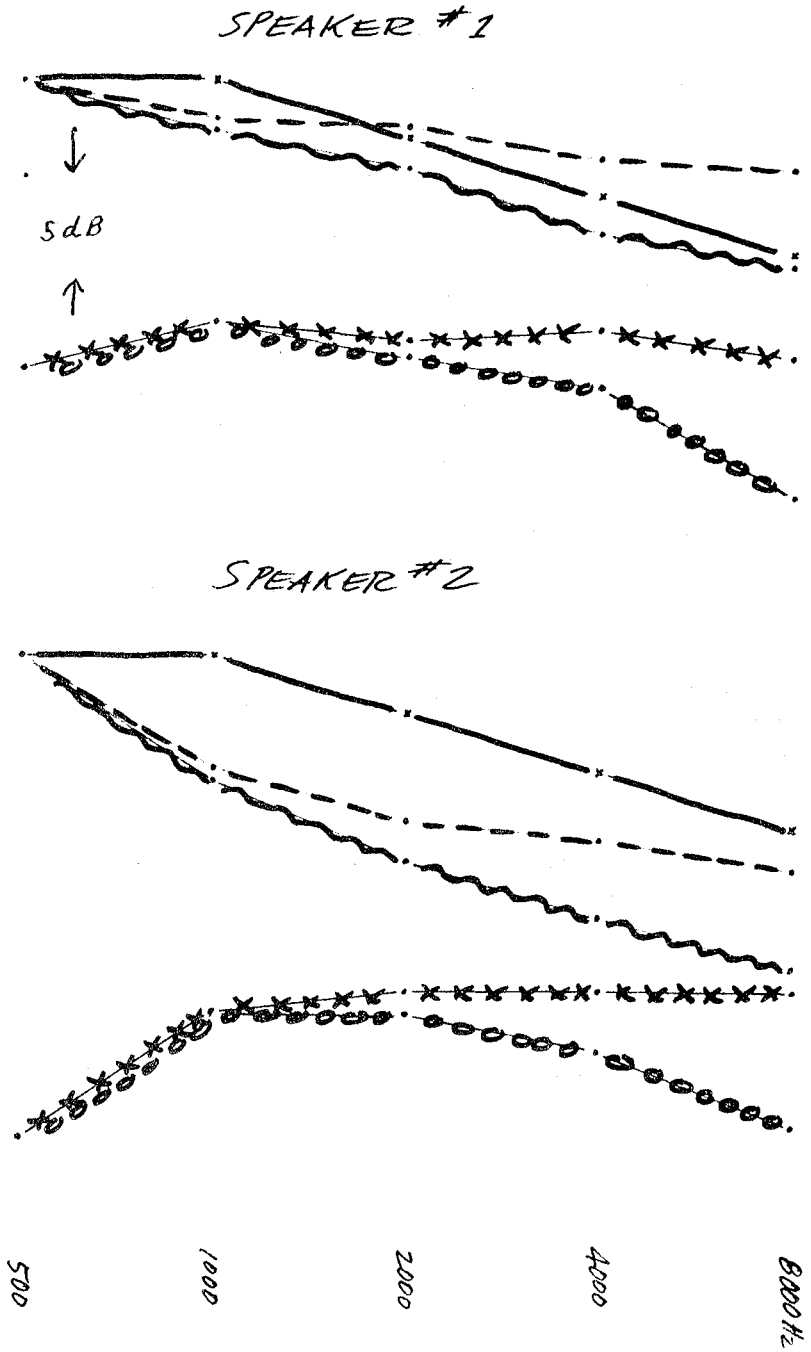
more

Sam Bridges, cont.

Assumption: Both speaker stems have flat on-axis direct field response.

The plots show that when the two speakers are equalized to the Preferred House Curve, direct response is substantially different. System # 1 would sound pretty good, but not System #2 (in my estimation).

System #1 PWL is from reverberant room measurements
System #2 PWL is calculated from polars (tediously).



ST. MARY'S HOSPITAL CHAPEL, ROCHESTER, MINN.

St. Mary's Hospital Chapel in Rochester, Minn. represents what happens when Syn-Aud-Con graduates collaborate.

The sound system was designed and sold by JOE SCHMID (DC class 1974) and CHUCK HATFIELD (Minneapolis class 1975), Hauenstein and Burmeister of Minneapolis. The installation and equalization of the sound system was by KEN STOLTENBERG (Minneapolis class 1973 & '75) of Electronic Engineering Services, Rochester, Minn.

The sound systems consisted of Frazier F12-4H loudspeakers along with a Frazier F-5A mixer and one Frazier F106C 50 watt amplifier. (Ken tells us that Precision Electronics of Franklin Park, Ill. builds these electronic units for Frazier.) Two Beyer M69SM and one M111 microphones are used.

The RT_{60} measures 3.0 seconds. (Frequency not specified but assumed to be around 1,000 Hz) Length of the church is 190'. The area under the balcony is lined with *polished marble*. Previously two sound columns had been tried without success. D_2 became only 30' in this installation. Ken said, "The building permitted a rather unusual installation procedure. As one could walk on top of the ceiling, holes were drilled in the ceiling, chains were dropped through the holes, and the speakers hooked on and then pulled up into place. Cover plates were made and fastened to the chain at the desired location so that when pulled up against the ceiling all speakers would be 30' above the floor. The cover plates were painted the same color as the ceiling so they are unnoticable and cover the hole in the ceiling. It is interesting to note that most people do not see the loudspeakers." Some of the Sisters who had been there for years wanted to know why they suddenly hear the Priest with such clarity and ease.

Equalization was performed with the UREI model 529 equalizer, "The UREI 529A works very nicely. This is the third one we have used since becoming a UREI dealer. On this particular application I appreciated the availability of the low and hi cut filters," Ken said. "The low cut filter was set about 160Hz and this reduced apparent room accentuation of frequencies below this. The hi cut was used to provide a complimentary slope on the hi end of the spectrum."

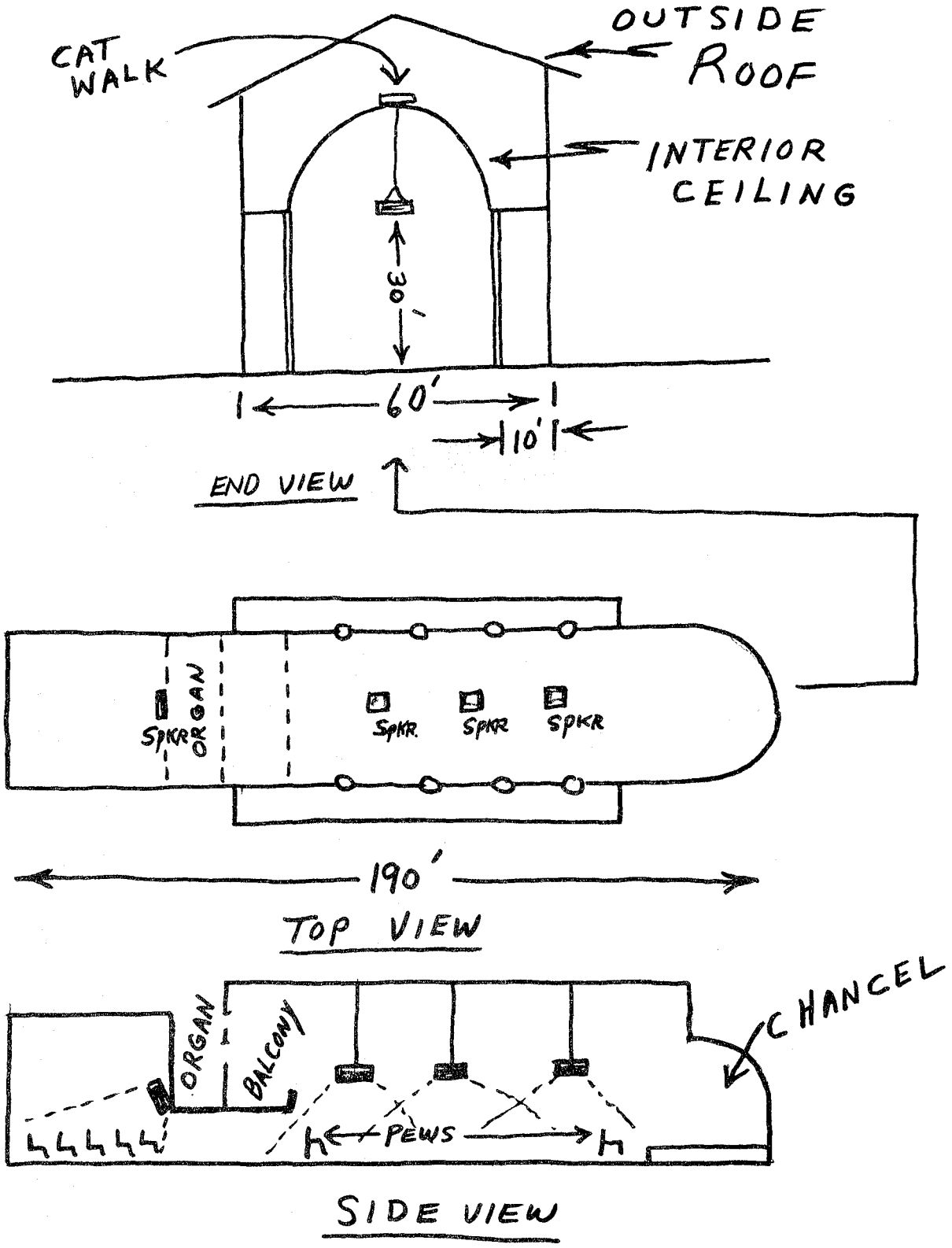
"The room was equalized using GR Pink Noise generator and Vic Hall's ARA-412 analyzer."

"You would enjoy the architecture of the St. Mary's Chapel. There are areas that cause one to recall the atmospheric construction of some of the old theatres. The grill covering the organ pipes in the balcony is made up of a number of large plaster castings. The West section (area with the wall mounted speaker) has a cast ceiling with intricately cast figures forming a border where the ceiling meets the wall. The artisans of this era have long since disappeared into the past."

By having reduced D_2 to 30 feet the listener then receives such a high acoustic gain that the Doak and Bolt criteria (acoustic gain at listener vs. time delay) allows interference free reception. A nice illustration of how to handle a difficult space with an economy of equipment through well thoughtout techniques.

more

St. Mary's Hospital Chapel, cont.



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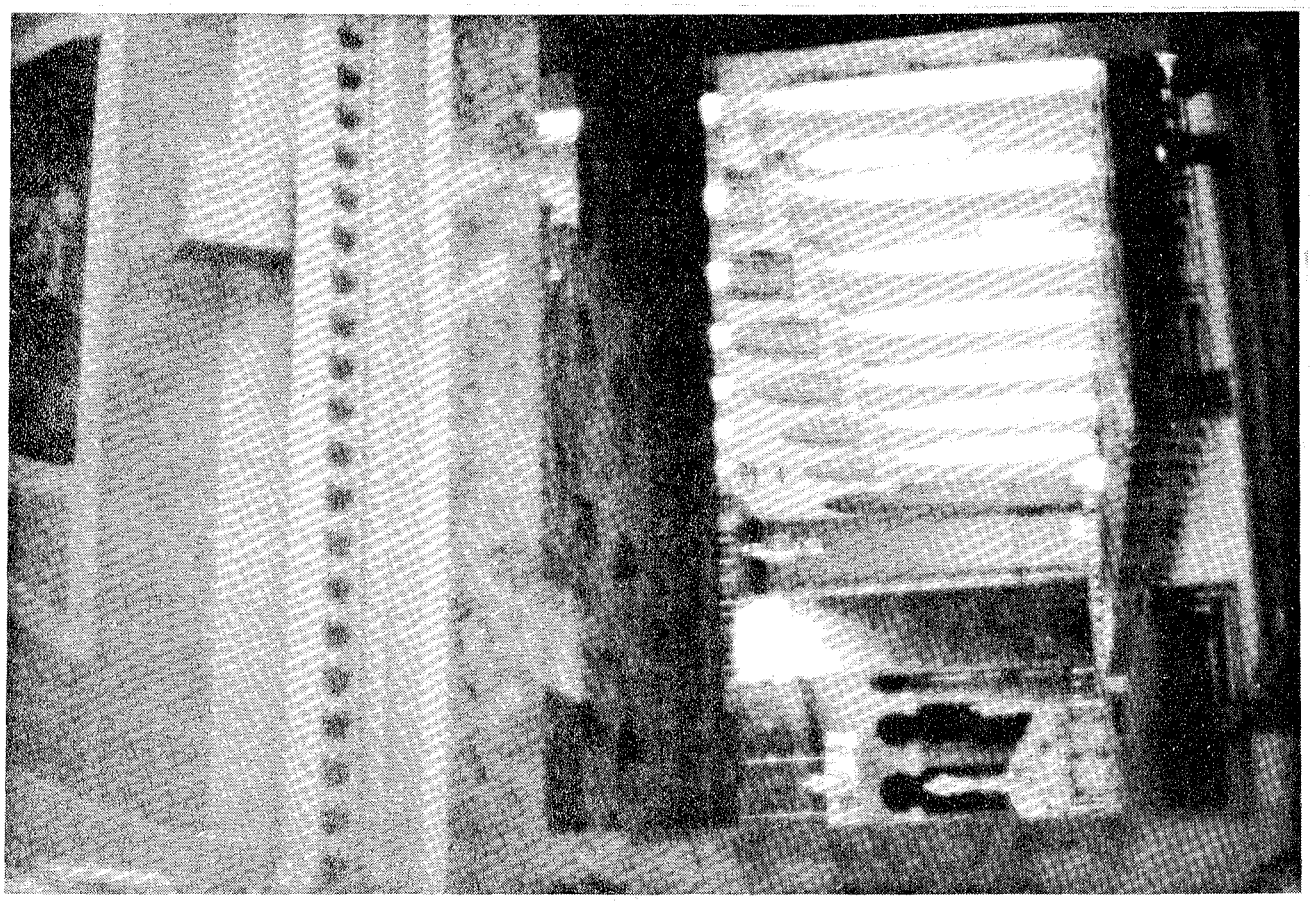
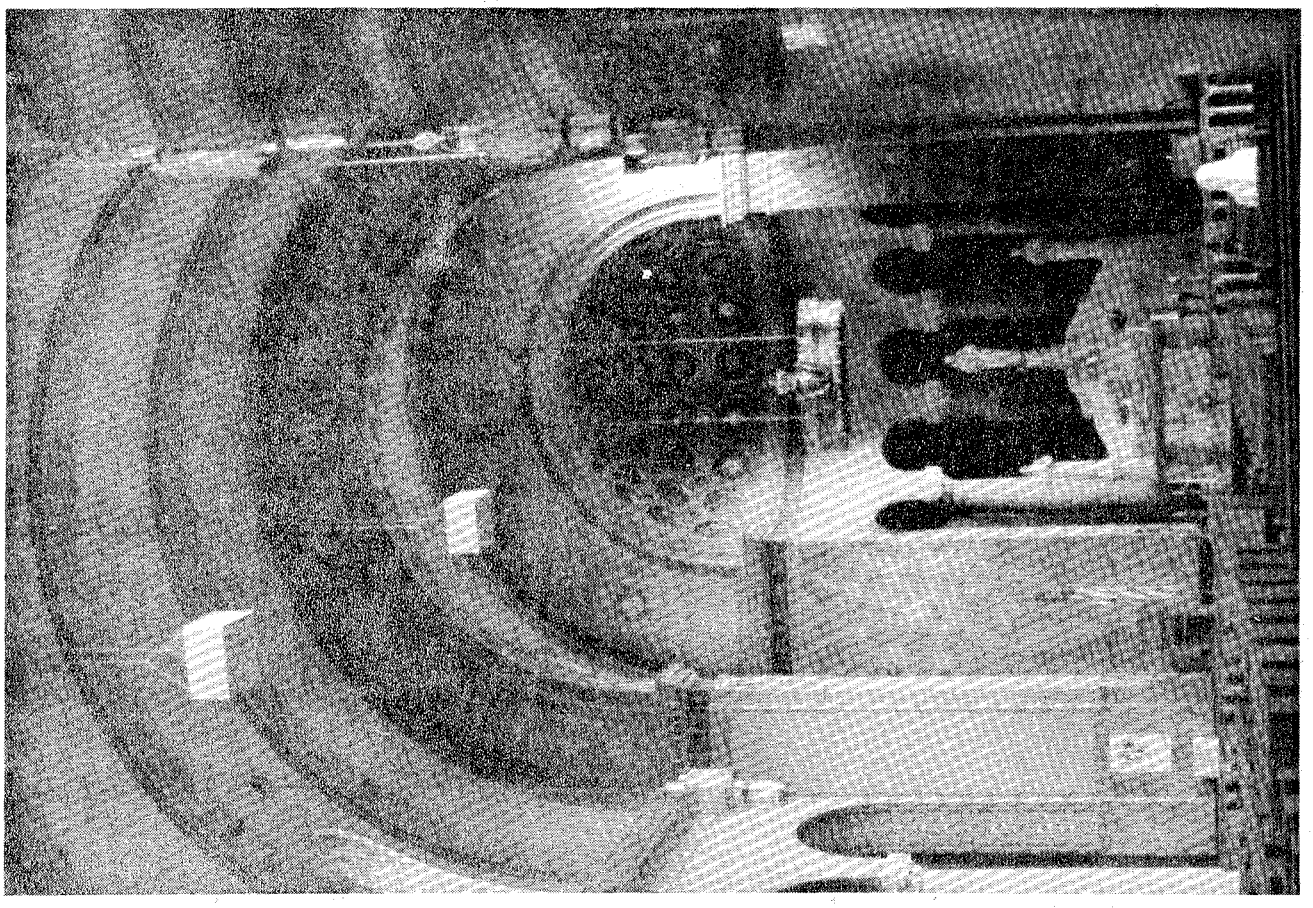




WANT TO SHARE YOUR HP 65 PROGRAMS?

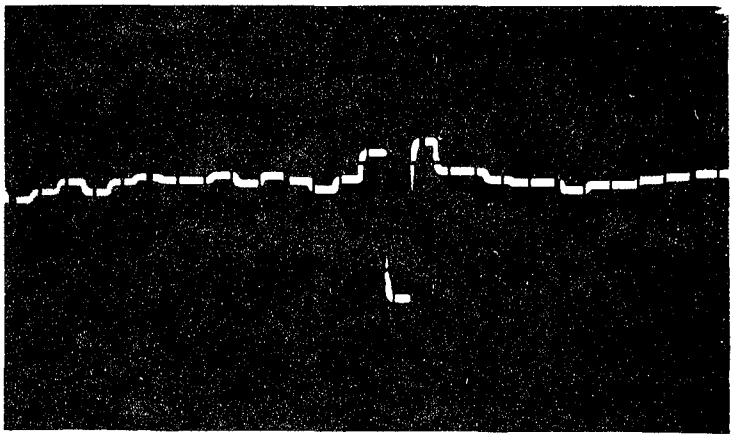
BILL KESSLER, Kessler & Wilhelms in Gainesville, Fla (Houston class 1973), "I note that the October issue of the Newsletter contains a list of HP-65 owners and that some of these owners have developed some sophisticated programs that they would be willing to share in exchange with other owners. So far, I have not developed any programs for my HP-65 that I could describe as sophisticated. My programs to date are restricted to calculations of reverb time, Hopkins-Stryker equation, critical distance, etc.

I wonder if you would consider publishing a list and brief description of the programs developed by Syn-Aud-Con graduates?"

We would like to have more HP 65 programs to share. If 65 owners will send us their programs, we will publish a list of programs available and their cost (photocopy charge) in following Newsletters.

MOTHER NATURE'S METHOD

Something to think about the next time someone talks about using boosting filters to tune a room -- Dick Heyser has pointed out that no two uncorrelated signals can add in a room to more than 3 dB but they can cancel to any depth. This obvious but often overlooked outcome of adding signals in a real room reminds us that Mother Nature does all of her adjustment of the signal in the room by removing energy not adding it. A filter bandwidth that does not precisely match the upper envelope of the room's modal structure can cause minimum difficulty if it is attenuating energy but a great deal of difficulty if it is attempting to add power to the system.



A boost filter on a commercially available 1/3-octave filter set. The 1,000 Hz band is boosted 10 dB and the 1,000 Hz band on the GR real time analyzer is 20 dB in the "cut" position.

SIMPLE, COMMONLY ENCOUNTERED METRIC CONVERSIONS

1 watt 1 meter sensitivities

$$\frac{100\ \text{cm}}{1\ \text{m}} \cdot \frac{1\ \text{in}}{2.54\ \text{cm}} \cdot \frac{1\text{ft.}}{12\ \text{in}} = \frac{3.281\text{ft}}{\text{m}}$$

Therefore, 4' is greater than 1 meter and the sensitivity number should be reduced for a 4' 1 watt rating

$$20 \log \frac{4'}{3.281'} = 1.72\ \text{dB}$$

Thus, a 1 meter 1 watt sensitivity can be converted into a 4' 1 watt rating by *subtracting* 1.72 dB.

CALCULATING RT_{60} AND $\frac{60}{RT_{60}}$ FROM LEVEL RECORDER CHARTS

With the advent of improved precision level recorders at substantially lower costs, such as the UREI Model 200 (automatic response plotting system) (soon to have a plug-in module for the measurement of reverberation time, RT_{60}), it seems appropriate to review the technique of calculating such parameters as RT_{60} and the decay rate, $\frac{60}{RT_{60}}$.

THE REVERBERATION TIME

The RT_{60} is, by definition, the period of time (usually in seconds) that it takes a steady state signal that is switched off to drop in level by 60 dB. The older GR 1521 high speed level recorder was available with an 80 dB potentiometer and a paper speed of 75"/min. The vertical scale was 20 dB/in. The "time base" chart paper used with this level recorder gave 5 divisions/sec. thus making each division 0.2 secs $\left(\frac{1.0}{5} = 0.2\right)$

The standard procedure was to have the paper running at its fastest speed, put the pen on the paper, and adjust the signal until the desired level on the chart was being traced horizontally. The signal was then shut off and the pen allowed to trace on the paper the changing levels as the reverberant field died away. A straight edge was then employed to obtain the straight line slope for the decay rate (since the potentiometer used for RT_{60} measurements is logarithmic as is the decay, the decay slope tends to a straight, sloping line). 60 dB is marked off vertically and the distance the sloped line traveled horizontally is noted.

A second way of obtaining the RT_{60} is to use the equation (formula from TOM McCARTHY, North Star Sound, Minneapolis - 1973, '74 & 75 classes)

$$RT_{60} = \kappa \text{ TAN } \angle$$

where:

$$\kappa = 60\left(\frac{60}{\frac{\text{dB/in on chart}}{\text{in"/min chart speed}}}\right)$$

$\angle$ = the angle between the decay's slope and the vertical

In our illustration

$$\kappa = 60\left(\frac{60}{\frac{20 \text{ dB/in}}{75\text{"/min}}}\right) = 2.4$$

and the $\angle = 26.5^{\circ}$

therefore:

$$2.4 \text{ TAN } 26.5 = 1.2 \text{ secs.}$$

THE DECAY RATE

The 60 dB of total change in level has a historical basis in the work of W. C. Sabine at the turn of the century. In recent years, it has been demonstrated that the first 15 to 20 dB determines the subjective response of the listener in a room. Indeed, due to dynamic range problems associated with high ambient noise levels in reverberant spaces and the need of excessively large loudspeakers, if the full 60 dB is to be obtained, any decay exceeding 15 to 20 dB is considered adequate for measurement purposes and is extrapolated to provide the RT_{60} number (4 x the 15 dB change and 3 x the 20 dB change in seconds).

Many acousticians prefer to think about reverberation as a rate of decay instead of an arbitrary time of decay. They use the number of dB/sec. as an operational figure.

$$\text{dB/sec} = \frac{60}{RT_{60}}$$

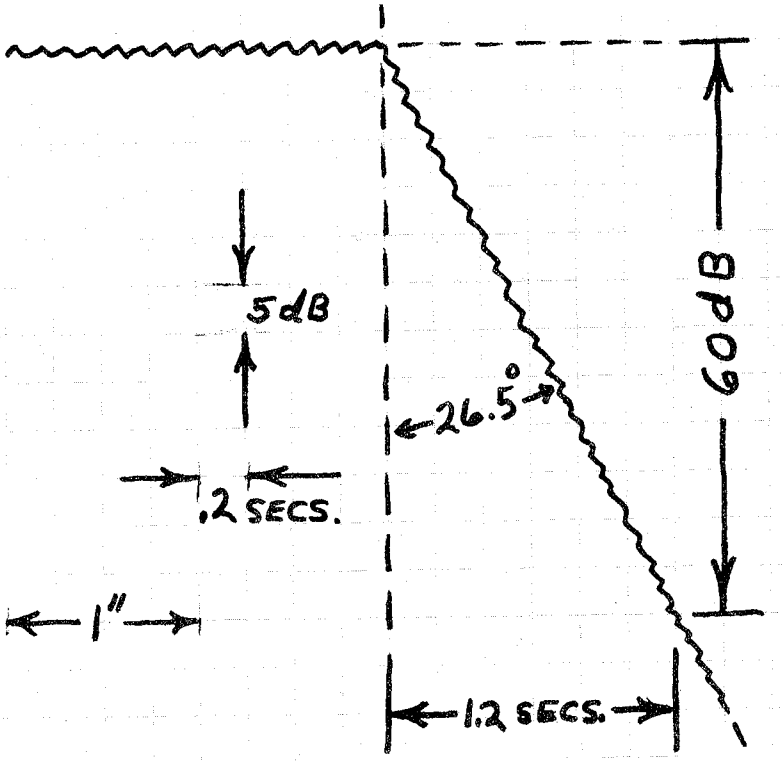
Calculating RT_{60} and $\frac{60}{RT_{60}}$ from Level Recorder Charts, cont.

Therefore, in our example figure, we could either count off how many dB our slope dropped in one second (five divisions/sec) or we could calculate

$$\frac{60}{1.2} = 50 \text{ dB/sec}$$

SUMMARY

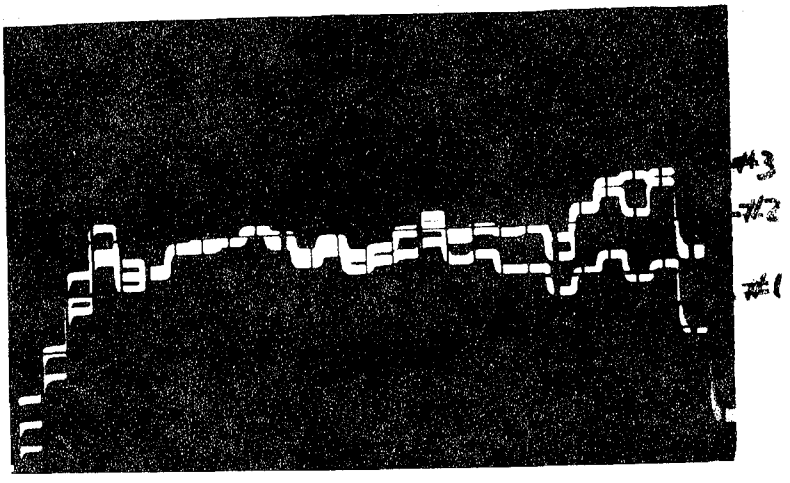
RT_{60} or $\frac{60}{RT_{60}}$ are normally taken at one octave intervals. The advantages of a level recorder over a direct reading meter are that echos may be clearly seen and identified, double slopes caused by coupled spaces observed, and you generate a permanent record for the customer and yourself. We look forward to the availability of precise, lower cost level recorders.



THREE SONY EMC 50'S MEASURED

FRANCIS DANIEL, New York class 1975, brought in 3 Sony EMC 50 Lavalier microphones to have curves run.

He said that subjectively one was "dead"--# 1; # 2 was "hot"; and # 3 was slightly "hotter". Francis took a bow to the applause of the class. It takes a trained, critical ear to hear a dB or 2 difference at a couple of frequencies across an entire band. Francis' work is in the movie recording industry.



NO COMMENT

From Concert News: Now we know. Thanks to county commissioners in Las Vegas, we finally have a detailed definition of a rock show (they needed one to get through an ordinance attempting to control them)....A rock show is a "public rendition of music in a permanent.. institution, consisting of several individual compositions performed by a musician or group of musicians utilizing electronically amplified instruments, which music is characterized by a persistent, heavily accented beat and a great degree of repetition of simple musical phrases.

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From a sound system specification - name withheld: This sound system can't afford 3 dB of head room.

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Wall Street Journal, March 23, 1976: Marketing men think the recession was also a culprit in shrinking the market for quadraphonic-sound equipment. When the four-channel gear hit the market in 1971, its boosters figured it would dislodge stereophonic, or two channel sound, from its preeminence in the world of high fidelity. But it never did get solidly entrenched in the market.

Marketing men think the recession wasn't the only factor. Manufacturers and record companies confused already-wary consumers with different types of equipment, records and tapes. Many stores were willing to stock only limited supplies, and some sound men think they failed to convince buyers that the improvement was noticeable enough to justify spending the $600 or more that easily could go into upgrading a stereo system.

Several makers of four-channel gear have begun jumping ship. An official of the Radio Shack division of Tandy Corp. says four-channel equipment accounts for only "infinitesimal" share of sales and he says the company plans to stop production by June. Harman-Kardon, a subsidiary of Harman International Industries, is dumping its quadraphonic receiver line "as quickly as our dignity and inventory allow," says Robert Greenbert, Harman-Kardon president.

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Associated Press, San Francisco: The government says it is actually cutting costs by "office-landscaping" a federal office with $10,000 worth of tropical plants and a 10,000 canned music system that features the sound of whispering surf. But one employee in the Labor Department office says, "If they'd turn the fans on for a tropical breeze and haul in a couple of tons of white sand we could be in Fiji."

Eighty-seven large plants - including eight potted palms - were installed in the sprawling offices of the Manpower Adminstration that occupy the ninth floor of the federal building here, Phillip Lawlor, Manpower's deputy regional administrator, has confirmed. Mr. Lawlor said a sound system soon to be installed throughout the floor will alternate 15 minutes of background music with 15 minutes of a "whirring, soft air-like roar," similar to the sound of surf.

The embellishments are part of a $90,000 "office landscaping, project recommended by the General Services Adminstration to save money by substituting foliage and low room dividers for costly interior walls," Mr. Lawlor said.

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From February 1976 ARCHITECTURAL RECORD: Westinghouse enters noise analysis work. Noise Analysis/Measurement and control of noise in industrial work areas is a new customer service offered by the firm. From a set of sound level measurements taken around a noise-producing machine, and at various distances from a calibrated sound source, technicians can provide a noise control design which should reduce noise in the work area to a predicted level. These designs use acoustic barriers and add acoustical absorption to designated wall and ceiling areas, avoiding the necessity of completely enclosing the machine. Westinghouse Industry Services Div., Westinghouse Electric Corp. Pittsburgh, Pa.

BOOKS OF INTEREST

ELECTRONIC FACILITY BONDING, GROUNDING AND SHIELDING REVIEW, prepared for the FAA November 1972, distributed by the National Technical Information Service of the United States Department of Commerce AD760 639. Cost $5.50. NTIS, Springfield, VA 22151.

ERIC AUGSTMAN, Supt. Communications Facilities, Ministry of Transport in Toronto (Chicago class 1975) sent us a copy of this fascinating basic review of the problems in the title. One very interesting point brought up in this publication is the fact that many water companies in order to safeguard their personnel from electrical shocks caused by grounding systems using the waterpipe as a way to establish earth ground are increasingly isolating their water pipe systems from the buildings they serve by installing non-conductive couplers outside of the building. This means that we shall increasingly need to establish our own grounding systems at new construction sites.

OUR ACOUSTIC ENVIRONMENT by Frederick A. White published by Wiley Interscience is a book of approximately 500 pages written as a "survey course" text. (To get on the mailing list for Wiley Interscience books, write Wiley-Interscience, 605 Third Ave, New York, New York 10016. You can examine any book for 10 days or so before deciding if you want to keep any book.) *Our Acoustic Environment* touches briefly on a majority of key points anyone interested in acoustics should be familiar with. Some small errors mar its maximum usefulness (Peutz is spelled Pentz and his important conclusions not referred to, for example, yet that he is aware of Peutz is to his credit). My overall feeling about the book is that it does a good job of surveying the field and is a worthwhile investment in spite of the oversights and minor errors (who publishes without them?.

AUDITORIUM ACOUSTICS. During a stop in London I took advantage of the time to go over the new technical books in London's largest technical bookstore - Foyles. I found a new title, *Auditorium Acoustics*, edited by Robin Mackenzie, published by Applied Science Publishers Ltd., London. $20 approximately.

Auditorium Acoustics is the proceedings of an international Symposium on Architectural Acoustics held at Heriot-Watt University, Edinburgh, Scotland. It contains twenty excellent articles from authorities such as Richard H. Bolt, Sandy Brown, Lothar Cremer, Vilhelm Lassen Jordon (on the new Sidney Music Hall), Heinrich Kuttruff, Peter Parkin (of Assisted Resonance fame), Manfred R. Schroeder, R.W.B. Stephens, and Paul Veneklasen to name but a few of the contributors.

The articles are well written with excellent illustrations. Mr. Bolt, in his article, makes the fascinating point about the number of new buildings where an acoustical consultant provides any service whatsoever is approximately 2 or 3 buildings in 10,000 (0.03% of new construction). This striking figure points out vividly why the sound contractor plays such a large role in specification writing and indicates the vastness of the undeveloped market for acoustic consulting.

The book provides a quick instructive view of what contemporary workers in the field of architectural acoustics are thinking about and working on. Foyles, 119 Charing Cross Rd., London WC2

A GUIDE TO AIRBORNE, IMPACT AND STRUCTUREBORNE NOISE CONTROL IN MULTI-FAMILY DWELLINGS, published by the U. S. Department of Housing and Urban Development and obtained through the Superintendent of Documents, D.C. 20402 for $4.75 was recommended to us by ALLEN BURDICK, Studio Technical Director of Christian Broadcasting Network in Ithaca, NY (Syracuse class 1975)
Octave band transmission losses of every imaginable type of wall, floor and ceiling construction, octave-band noise levels of common household appliances, and installation techniques of everything from towel racks to garbage disposal units in a manner that minimizes noise. A real bargain at $4.75. The ideal way to obtain a "feel" for relative noise isolation properties of commonly encountered types and techniques of construction.

ARTICLES OF INTEREST

The JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA has recently published two articles of special interest to Syn-Aud-Con graduates.

The Changing Role of the Expert by Leo L. Beranek, JASA Vol. 58, No. 3, September 1975, pp 547-555, is most interesting. The article discusses the early foundations of noise control work, Lincoln Center's acoustical problems, and where Mr. Beranek feels the acoustical expert is headed.

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Historical Review of Horns Used for Audience-type Sound Reproduction by John K. Hilliard, JASA Vol. 59, No. 1, January 1976, pages 1-8. Dr. Hilliard not only reviews the key early work but includes material to remind us that acoustic lens can be made to have a lower Q on-axis and a higher Q off-axis. The article contains many interesting photographs relative to the history of the horn loudspeaker.

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Hearing Loss of Rock Musicians by Dr. David Lipscomb, AUDIO MAGAZINE, pages 32-36 in the March 1976 issue. The article is interesting and thought-provoking. Dr. Lipscomb confirms that today's young people by the time they reach college have already experienced abnormal high frequency impairment of their hearing -- not however due to music -- but more to automobiles, snowmobiles, motorcycling, sporting arms, etc. Dr. Lipscomb makes a fascinating point with a theory of less damage to hearing from "noises" considered pleasurable than from those "noises" that cause strain and tension which constrict the veins and arteries, hence reducing the amount of oxygen-bearing blood cells which plays a role in damaging the inner ear.

CLASSIFIED

WANTED: Two (2) each of the following types of passive filters: Altec 9013-0, 9013-1, 9013-2, 9013-3, 9013-21 and 9013-23. Sam Adams (see ad below for address)

WANTED: Impedance Bridge, used, but in operating condition, appearance not important. Need not have functioning internal oscillator, but must have provision for connecting external oscillator. General Radio type 1650, or similar. Sam Adams, P O Box 1948, Ft. Benning, GA 31905