AUDIO

OCTOBER
1971 60c

LONDON LETTER

The Authoritative Magazine About High Fidelity ® A

SPECIAL ISSUE ON

QUADRAPHONICS

CBS SQ ⊛ EV STEREO-4 ⊛ DYNA II

SANSUI QS ⊛ JVC CD-4

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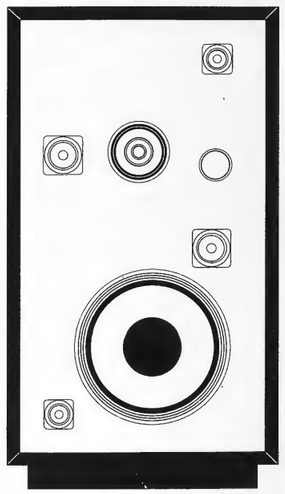

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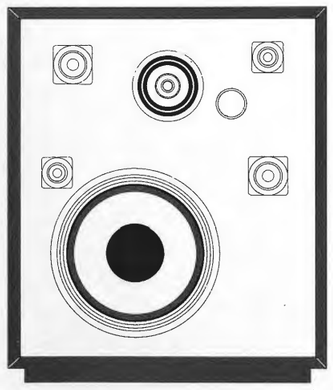

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Coming In November

The Loudspeaker in the Living Room—Roy Allison

Christmas Buyers Guide

Equipment Reviews Include:
Panasonic SA-6500 Receiver
B&W 70 Loudspeaker

Plus
Record Reviews and all the regular features.

Late News
Vanguard will release 12 quadraphonic records using the CBS SQ system this fall.

About The Cover: This shows part of an elaborate quadraphonic installation in a Philadelphia home, Main Line of course. The decoder is an E-V Stereo-4, amplifier a Scott 499, the tuner is a Sony 5000 and the 4/8-track player a Toyo CH-702. The Garrard SL-95B record player is fitted with a Pickering 750E cartridge and the speakers are E-V Century 1's. Dynaco A-25 speakers are in another room with Utah outdoor speakers located by the swimming pool. The installation was carried out by Fourplay, Inc.—which should arouse some interest.

Audioclinic

JOSEPH GIOVANELLI

Microphone Phasing

Q. I have been told that, when I make a recording, my microphones must be in phase. What would happen if they are not in phase? How would I go about making sure they are in phase?—Louis Hone, Montreal, Canada.

A. You know why it is a good idea to have your speakers in phase. This same reasoning applies to microphones. Consider a mono taping session. If a sound is fed into two mikes at once, that sound will be cancelled or reduced in amplitude if the two mikes are out of phase. Suppose the sound under discussion enters the two mikes, but the gain of one of them is turned down. As the gain is raised, however, the signal level actually can decrease rather than increase as would be expected. Further, this will not happen in a flat response across the audio spectrum. The sound will be strange to hear. If the sound source moves with relation to the mikes, the character of the sound will change, something like the sound of selective fading on shortwave reception.

To determine whether a pair of microphones are in or out of phase, connect them to two positions on a mike mixer. The two positions should be on the same channel. Place the two mikes next to each other. While speaking into both mikes, bring up the gain of one of them. Observe the VU meter. Bring up the gain of the second mike. If the signal increases in amplitude, the mikes are in phase. If the amplitude decreases, they are out of phase. If you do not have a meter at hand, listen to the output of the mixer via headphones. Of course, passive mixers and even some active ones must be amplified so you can observe the signal.

RF Boosters

Q. How can an antenna amplifier (booster) be any help to a sensitive tuner or color TV set? Isn't the built-in amplification of signal all that could be built into the set?—Joseph P. Laronda, Cheshire, Conn.

A. A booster may well not help a tuner or TV set. This is a matter of the relative signal-to-noise ratios of the tuner and the booster. If you take a tube-type booster and add it to a modern FM tuner, with its FET front-end, you definitely will amplify signal. You will also add more than signal. Hence, weak signal reception will be decreased. Of course, if you have an older tuner, and you have a FET booster, the situation will be reversed. The booster will improve reception, with one possible exception. Sometimes the booster will build up signals to such a point that the set will be overloaded. Unfortunately such a booster will amplify strong signals as well as weak ones.

I prefer to use a better antenna, with a rotator. The directionality of the antenna improves weak signal reception, rejects some noise, and if the desired signal lies in a direction other than that of a stronger station, this stronger signal is not intensified.

The only time that a good tuner or television receiver can be helped by a booster is when there is a very long connecting cable between the receiving antenna and the set. Several dB of signal is sometimes lost across the interconnecting cable. This cable can pick up a small amount of ignition noise plus some FM signals. In other words, the cable is, in part, acting as an antenna. The signal from the actual receiving antenna plus that picked up by the interconnecting cable can produce some multipath distortion. In addition to this, the ignition noise picked up by the cable will degrade the signal still further. A booster, when mounted between the antenna and the lead-in cable, will amplify the signal to a point where signal pickup from the cable, noise picked up by the cable, and signal losses within the cable will all be overriden.

Of course, the booster will amplify strong signals as well as weak ones, as has been said. Hence, you still run the risk of overloading your tuner or TV receiver.

Of course, when solid state devices come along which are better than FETs, such devices will find their way into RF boosters. The use of such boosters will, of course, bring about an improvement in the performance of even today's FET-equipped tuners and receivers. Again, however, strong signals will cause overload.

Response Requirements

Q. Is frequency response above 15,000 Hz and below 50 Hz really essential for realistic recording?—Nicholas Rico, Rochester, N.Y.

A. Response essentially flat from 50 to 15,000 Hz is consistent with professional standards. In other words, response outside this range is not really essential, although nice to have.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped self-addressed envelope.

Tape Guide

HERMAN BURSTEIN

Low Recording Volume

Q. I have a Cipher VII stereo tape recorder. Here's the problem. When I play a tape that was recorded on another machine, the sound comes out loud and clear. But when I record something on the Cipher VII, the playback is very low (but not distorted) with the volume controls all the way up. Both channels are the same. I record at a high level, with the meters pointing near the red area. Voltages all check good, tubes good. I replaced the oscillator tube, but this made no difference. Continuity on the oscillator coil checks out; so do the switches. Erase is very good.—Vincent Malisa, Union City, N.J.

A. My initial thought is that the VU meters may be miscalibrated, giving too high a reading. Have you tried recording with the pointers well past the red? If you still get undistorted sound with good frequency balance, this suggests miscalibration of the meters. One would tend to suspect loss of bias current to the record heads, were it not for your statement that the sound is undistorted upon playback. Are you *sure* it is undistorted? If further listening reveals distorted sound, then you have a loss of bias; corroboration of loss of bias is accentuation of the treble range.

Tape Troubles

Q. I own a Roberts 450 tape deck. When recording any type of material on a 2400 foot reel of Audiotape Formula 10 tape, ½ mil, everything goes fine until about three quarters of the way through the reel. The flutter then becomes ridiculous. It sounds as if the music were being played under water. I keep the capstan and roller clean, and the heads demagnetized. Other tapes recorded on other machines do not show any of these effects when played back on my machine. The abnormal flutter occurs at about the same spot on the majority of the Audiotape reels. However, the one reel of ½ mil tensilized Scotch tape I have shows no flutter. Is the problem in the tape I have selected or in my machine?—Kenneth E. Wood, Potsdam, New York.

A. I really cannot answer your question except to repeat what you already recognize: Your machine fails to work well when using a specific brand and kind of tape. The fault is likely not in the machine, and likely not in the tape, but in a combination of the two—owing to reasons hard to fathom. This is not so unusual. I have had a number of reports that specific machines of high quality fail to work well with specific tapes also of high quality; for example, a particular combination may produce squeal.

Choosing a Tape Deck

Q. I am thinking about buying a tape machine, but selecting one from the overwhelming variety of tape decks, tape recorders, cassette units, etc. is quite bewildering to the non-expert. Could you give me some advice? Is there any chance that I could run into a tape noise problem?—Chester Sackett, Forest Hills, N.Y.

A. Your selection of a tape recorder will have to be guided by what you read in the way of equipment reviews, by what you hear in the audio store, and by your purse. A good test is to copy a high quality phono disc and compare the tape recording with the disc. As a broad rule, the more you spend, the better machine you will get from the viewpoint of performance, flexibility and features, and durability. One of the things you will get from a quality machine is reduced noise, which is one of the chief problems in tape recording. For high fidelity performance, reel-to-reel machines are still preferable to cassettes, although the latter are steadily improving in quality.

Half-Track vs. Quarter-Track

Q. I am planning to offer a professional recording service and want a tape recorder which can serve three purposes, as a professional machine, as an aid and reference machine in the service business, and also as a fine home unit. The conflict is that I would prefer quarter-track for the second and third purposes, but should probably have half-track for the professional application. Please comment.—Herbert A. Rader, State College, Pa.

A. For professional quality, I think you would want stereo recordings to be half-track, for this will give better signal to noise ratio than quarter-track. Also, dropouts will tend to be less of a problem. Further, you are less apt to have "left channel dropout," namely a weaker signal on the left channel than on the right owing to poorer contact between the upper gap and the tape than between the lower gap and the tape.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

BEHIND THE SCENES

BERT WHYTE

As we head into the fall months, traditionally the beginning of the "audio season," the record industry is still without a standard for a four-channel disc. Perhaps by the time you read this, this problem will have been resolved; as I write, the protagonists of the various matrix systems are locked in battle. While hardly a day goes by that isn't rife with rumors of "definitive" new systems and "blue sky" proposals for "discrete four-channel" discs, it is probably fairly safe to assume that as far as records are concerned, some form of matrix system will prevail. It must be realized that with disc recordings the main program source of FM stereo broadcasting, the industry is virtually "locked in" to the idea of matrixing for four-channel stereo. I agree entirely with colleague Len Feldman, co-inventor of the EV system, who points out that it is highly unlikely the FCC would make any decisions on discrete methods of four-channel stereo broadcasting for many years. If we are to have "quadricasts," it will be via one of the encoding/decoding matrix systems, and as I am sure you are aware, the FCC has already granted permission for the broadcast of several varieties of matrix systems.

Where does all this leave the audiophile who wants to get into the four-channel act *right now,* without running too much risk of acquiring equipment which may rapidly become obsolete? There are two obvious routes . . . four-channel discrete stereo on open reel tape, and the discrete four-channel, eight track cartridge. As I have pointed out before, while open reel four-channel stereo is indisputably the tops in quality, the amount of program material in this format is very limited. I don't think there is any question that when the overall four-channel stereo market expands sufficiently, there will be a plentiful "spin-off" of open reel material. For the present, it would appear that the four-channel stereo cartridge has the least expensive hardware and the most program material, thanks to the RCA sponsorship of this format. This format also has going for it the fact that equipment is available to play the cartridges in cars as well as at home. In terms of pop/rock music, this dual facility is much appreciated by the "under 30" types. The car equipment will begin to show in quantity with the 1972 models, and as I pointed out, there was a plethora of units for home use at the CES in Chicago. One of the first four-channel stereo cartridge players to reach the market is the Fisher CP-100. I have been living with this unit and a goodly supply of RCA "Q8" cartridges, familiarizing myself with this format.

The Fisher CP-100 is a product aimed specifically at the audiophile who already has four channels of amplification and four loudspeakers. In other words it is a cartridge "deck," meant to be plugged into appropriate high level inputs on two pre-amplifiers or integrated amplifiers, or a four-channel receiver such as the Fisher 601 or 701. The CP-100 is a compact 4⅝ H × 10-3/16 W × 10⅛ D, with an attractive walnut finish. On the escutcheon of the unit are two red indicator lights which show whether a two-channel or four-channel stereo program is being played. There are also four other indicator lights which show the program being played on a two-channel cartridge. There are three control buttons which allow the programs on the cartridges to be played consecutively, repeated, or changed at will. The player "senses" whether a two-channel or four-channel cartridge has been inserted by the configuration of the cartridge case. Standard two-channel cases activate the player in normal fashion. A four-channel case has a groove molded on the top left, which when inserted engages a switch putting the unit into the four-channel mode. Claimed frequency response of the CP-100 is 50 to 12,000 Hz and this would seem to be in line with the performance of the unit. With the best quality cartridges playback was smooth and clean. Wow and flutter was very good as indicated by the stability of sound in sustained passages of music and fixed pitch instruments like the piano. Program change in either two- or four-channel mode was quite rapid and positive. With the CP-100, it is recommended that the unit be placed a minimum of six inches from any power transformers. With more than three feet of separation in my set-up, hum was inaudible. All in all, the CP-100 does the job it was intended for, with quiet efficiency and exemplary quality.

Okay, we have a good player which isn't going to degrade the quality of the cartridges. What about the quality of the four-channel stereo cartridges themselves? In this case when we talk about quality in addition to the normal parameters of frequency response, signal-to-noise ratio, distortion, cross-talk and print-through, we must assess the four-channel stereo aspects. What about channel separation, front to rear balances, enhancement of acoustic perspective, heightened instrumental definition?

Much has been made about the fact that Q8 cartridges are *discrete* four-channel stereo. Indeed they are, but at the risk of becoming boring, I once again draw your attention to the fact that with this format or with open reel, material mixed down from eight and 16 channel pop/rock masters is in the strictest sense *monophonic* four-channel. With "pan-potting" for directionality and controlled amounts of reverberation added for a sense of liveness and spaciousness, they satisfy most consumers' idea of stereo, so we'll let it go at that.

The RCA four-channel stereo cartridges that have been issued thus far are largely music we are familiar with in the two-channel stereo format. Thus we have numerous offerings from Hugo Montenegro and his orchestra, ditto for Henry Mancini. These are typical of other "surround" type of four-channel sound, with equal amplitude of front and rear channels. However, it must be noted that although the RCA cartridges feature good separation, with each of the four channels perfectly delineated, the mix-downs are rather static in comparison to the Enoch Light/Project 3 material. If we are going to have this kind of four-channel stereo pop gimmickry, if, as some suggest, this be treated as a new "art form," then we should be as imaginative and creative as possible. In the RCA case, the orchestra is separated into four channels and there they sit, with little or no interaction. If some guy is playing a guitar to your right rear, after a short while you become very conscious and irritated with his constant "plunka-plunka." With the Enoch Light material there is considerable dynamic interplay, sometimes with emphasis shifting from front to rear and vice versa, and the same with lateral directivity and even on a diagonal "criss-cross" basis. In short, Light's recordings show more creative use of the pan pot "joystick." That aside, the RCA recordings are as clean and bright as their two-channel counterparts, with the undeniable gain in impact and interest of the four-channel format. So far, so good. Next RCA four-channel stereo offerings I sampled were of all things, Broadway shows. I approached them with considerable trepidation, for I knew that they had never been recorded in the classic four-channel mode, and that with this kind of material not only was gimmickry out of place, but that it wouldn't work. Well, I confess I was quite surprised to find them not at all like I imagined. In the original cast "Fiddler On The Roof," with the incomparable Zero Mostel, it took a bit of time getting used to hearing the music and the voices of the cast behind you as well as in the normal perspective. But I noted a definite gain in intelligibility and a most uncanny sense of "participation." Logic tells you that you don't hear this sort of thing in the live experience of the theatre. Can't really put my finger on the whys and wherefores . . . but it works! More movement, more dynamism here too. You perceive left/right movement on your "stage front," a voice will call from front left and other voices will answer from left rear and then right rear. The effect is more than you get in the flat plane of regular two-dimensional, two-channel stereo . . . the extra channels furnish a three-dimensional effect that makes for a more solid acoustic image. This reporter found a definite enhancement of the emotional impact of this recording through the use of four-channel stereo. Much the same can be said for such other Broadway recordings, as "Hair" and "Hello Dolly," although the overall effect is in proportion to the quality of the original recording. For example, "Hello Dolly" is a less detailed recording, with somewhat amorphous choral work, as compared to "Fiddler." Thus the sense of participation in this recording is notably less.

RCA has issued more than 70 four-channel stereo cartridges and, as noted above, has fared well with the "pop surround" and Broadway play categories. They have in their initial release quite a number of classical recordings, and I regret to say that here we have total disaster. First there is a moral or at least ethical offense in the purveying of such items as Van Cliburn's famous recording of the Tchaikovsky Piano Concerto #1 and "Victory At Sea" as four-channel stereo recordings. Four-channel stereo in 1959? C'mon fellas!! There are other modern stereo recordings, such as Ormandy doing the "Pathetique," Ozawa with the Firebird and Petrouchka, Rubinstein performing several concertos, and others of similar ilk, which were never recorded in four-channel stereo. How then are these and the aforementioned older items four-channel recordings? By the unbelievable expediency of taking middle channel information (mostly woodwinds with a little strings and brass) from a master recording and *splitting it left and right to the rear!* Net result of course is that you're hearing the instruments behind you, and RCA aggravates matters by recording the rear at equal amplitude with the front channels. In the case of the concertos, the piano is heard from the rear channels. In other words, none of the classical four-channel stereo cartridges issued by RCA have been recorded in *true* quadraphonic sound, with the goal of capturing the acoustic ambience of the recording hall, the multiple reflections from walls, floor and ceiling, that lend three-dimensional realism to the sound.

Why RCA chose to issue recordings like this is baffling. If they had issued a few cornball classics like . . . "The Best of the Boston Symphony" or some such thing as a sop to the poor classical market, it would be understandable. But they have issued fine top quality recordings which obviously are known by and appeal to the classical music devotee. The most avant garde and liberal of these music lovers would never concede that there is any musical validity, any reason to hear instruments all around you. It is simply alien to the concert hall experience. While many concert-goers may have secret "Walter Mitty" dreams of standing in the conductor's shoes, even the conductor isn't engulfed with sound all around him. No, I don't think any concert-goer who owns top stereo equipment for the express purpose of getting as much realism as he can from his recorded music is going to accept this outrage to his musical sensibilities. The four-channel discrete stereo cartridge works fine in the pop and show categories. RCA has done a nice job of processing their cartridges. I'll grant that tape hiss is still a bit of a problem and doesn't help in presenting rear channel ambient information, but as things progress Dolby can take care of that. I really sincerely suggest that RCA would be better off withdrawing their present classical so-called four-channel cartridges from the market and replacing them as soon as possible with the genuine article. The four-channel stereo cartridge has great potential. Let's hope RCA has some concern for the classical market, even if it is only 5 percent!

Exciting news from Dolby this month. Columbia records will issue all their cassettes with Dolby B type noise reduction. Columbia's first Dolby release will number 18 titles, with such interesting works that will obviously benefit from B type noise reduction as Ormandy and the Philadelphia doing the Prokofiev 5th Symphony and Boulez conducting a Ravel program with the Cleveland Orchestra. With Columbia in the Dolby fold, along with English Decca, Ampex Stereo Tapes, Vox Records, and several other labels, can the rest of the industry be far behind? At last count, there are now close to 200 Dolby B Type cassettes available. I'll be getting some of the new Columbia/Dolby cassettes very soon and look forward to reporting on them.

What's New in Audio

Rotel RH-700 headphones

These dynamic headphones from Rotel are specified as having 20 to 20,000 Hz response and an impedance of 8 to 16 ohms. Distortion is said to be 1.0 percent or less. The unit has a 12 ft. coiled cord and weighs only 12 oz. Price: $25.00.

Check No. 131 on Reader Service Card

Koss headphone connector

The Model T-4A allows up to five persons to use headphones at a single time. The useful gadget is six inches in diameter and has a spun aluminum face with a walnut-like base. Price: $12.95.

Check No. 132 on Reader Service Card

Toyo Model 850 cassette adaptor

This accessory unit allows the user to play cassette on an 8-track cartridge player. It accepts any standard cartridge and plugs into any standard 8-track cartridge player, the same way an ordinary cartridge does. Price: $29.95.

Check No. 133 on Reader Service Card

Jensen Model 4 speaker

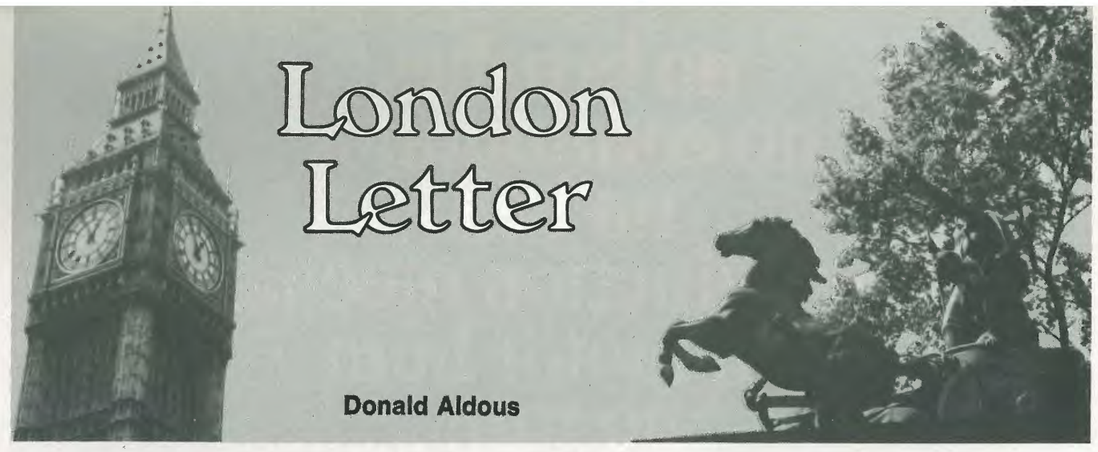
This three-way system uses a 10-in. woofer, a 5-in. direct radiator for mid-range, and a Sonodome (R) tweeter to produce a response of 36 to 30,000 Hz. Impedance is 8 ohms, and crossover frequencies are 500 and 4,000 Hz. Size is 24x13x12 inches, and weight is 46 lbs. Price: $99.00.

Check No. 130 on Reader Service Card

Lafayette F-2001 headphones

These electrostatic headphones are said to have a response of 5 to 30,000 Hz and have an impedance of 4-16 ohms. The energizer, which converts the signal to the d.c. polarizing voltage, is included. The coiled cord is 10 ft. long. Price: $59.00.

Check No. 129 on Reader Service Card



London Letter

Donald Aldous

IN TODAY'S WORLD the cost of silence (or minimal noise) is becoming increasingly expensive and difficult to achieve. You will all be familiar, I'm sure, with the problems of noise pollution in our environment, but I do not propose to deal with this theme now. However, this area has been occupying some of my time lately, in relation to fitting up a studio for working and listening in. I soon discovered the cost of acoustic treatment had risen significantly since similar conversions I had tackled in the past, and, later being called in as an "expert" witness—curiously for the defendant, as after an investigation my sympathies lay with the complainant!—in a legal case where the sounds of a noisy dance-hall group were disturbing the occupants of adjacent premises. The case was settled out of court, on my advice, by undertaking structural alterations and adding effective sound proofing—at a price!

It is not surprising that floor-trembling volume levels can be attained by "pop" groups, as I have just seen the details of the stage sound equipment used on tour by a trio called Emerson, Lake and Palmer. These performers have some L 20,000 (sterling!) of equipment and have produced several best-selling record albums, following tours of Europe and America, with sell-outs, so I was told, at Carnegie and the Fillmore Halls.

Travelling with their own audio engineer (John Robson), the equipment includes a Moog Synthesiser IC, Hammond C3 and L100 organs, two Leslie 122 speaker cabinets, one PRO 900 amplifier, two 100 watt Hi-Watt amplifiers and loudspeakers (for Keith Emerson); several guitars—Gibson J300 Acoustic, Fender, Jazz Bass, modified Telecaster, plus two 200 watt Hi-Watt amps. Add four custom-built loudspeakers for Greg Lake. Carl Palmer's kit consists of various drums kits, gongs, etc. The PA system proper comprises four folded horn LF enclosures, eight Vitavox diffusion type horns, two Crown DC 300 power amplifiers, 11 Quad (Acoustical) 303 power amplifiers, with a custom-built 20 channel mixer and six WEM monitor column speakers. Microphones include six AKG C451 capacitors, six AKG D224 dynamic types, four AKG D12 dynamics, and five AKG D190 dynamic models. Cor, it makes yer think!

Glancing at my books on noise, I found a 1935 text by Dr. Norman McLachlan (whose monumental 1934 text on the mathematics of loudspeaker design and performance some older readers will remember), and I recall his device for tackling "scratch" or surface noise on discs—the Gambrell Novotone. Many devices have been created for this purpose, from primitive contrast expansion circuits to sophisticated noise filters. Some recent measurements on certain British hi-fi amplifiers, with adjustable slopes as steep as 50 dB/octave have produced some notable figures. With a 50 dB/octave characteristic, chopping off at 9 kHz, the filter removes some 21% of the noise, which is nearly as much as 2 kHz 6 dB/octave filter, but removing only about 1.8% of the program content.

By now you will have guessed that I am leading up to the present-day work in hand by various audio engineers on noise-suppression circuits for tape recording, replay, etc. The big news here is the announcement of the Philips phase-compensated active noise-suppression circuit, christened the Dynamic Noise Limiter.

Philips has propounded their philosophy in this field by referring to the tendency of some designers to improve noise figures or frequency response at the expense of compatibility which solutions for this reason, plus price considerations and drift problems, they claim are not acceptable to the Philips organization, the originators of the Compact Cassette System.

Complete compatibility is a prime requirement, so that—in the view of the Philips' engineers—the industry is obliged to prevent obsolescence of existing products, whether hardware or software. This simply means that any prerecorded cassette should be playable on cassette equipment of any make, without reference to tape speed, or mono/stereo mode.

To this end Philips has developed this latest noise-suppression circuit which could well bridge the gap between the present state of the art and future developments without rendering obsolete existing cassette collections.

These remarks obviously refer to the developments in hand on magnetic tape formulations (chromium-dioxide, the latest "high energy" Coballoy coatings, etc. from BASF and 3M, etc.) which allow for more favourable recording and replay equalizations on a "normal" tape without any doctoring in record or playback.

I understand an IEC proposal is in circulation to standardize a secondary standard for slow-speed tape recording with a recommendation that is clearly aimed at the application of these so-called "high density" tape media. It has been recommended that the present time constant of 120/1590 microseconds should be replaced by 70/3180 microseconds as secondary standard. This proposal has already been tested as far as its application with CrO_2 material is concerned. It certainly appears that magnetic tape manufacturers confronted with the threat of new developments have intensified their efforts on regular ferro-oxide formulations (whether doped or not) to approximate the results obtained with non-ferrous formulations. Some workers think that a sort of breakthrough in this area will be made by the end of 1972.

The Philips circuit makes use of the two characteristic properties of music, namely, (1) suppression should be complete during absence of signals and inoperative during loud signals. A low tripping level may pass more noise

(Continued on page 18)

Editor's Review

MOST OF THIS ISSUE has been given up to quadraphonic sound with detailed explanations of matrix systems. We make no apologies for this because we at AUDIO believe that quadraphonics is another step towards the realistic reproduction of sound—particularly in the home. Naturally enough, each company concerned believes its own system is the best and the claims are published so that readers will have a better understanding of what is involved. It is also possible that the dissemination of such information will help in a small way towards eventual standardization. Each system examined appears to have some advantage—either separation, mono compatibility, economy, localization or low distortion. If only these virtues could be combined in one system!

Harry E. Maynard

This month a new name appears in our list of contributing editors—Harry E. Maynard, formerly of FM Guide. Harry is well-known as the sponsor of the "Men of Hi-Fi" series broadcast by radio station WNYC of New York. This is the municipal station which operates on a frequency of 94.9 MHz and the programs can be heard on Saturdays at 4:30 p.m. and Sunday evenings at 10:30. The program really covers a wider area than its title suggests, and all kinds of hi-fi topics are discussed by a panel which often includes Len Feldman, Edward Canby, Bert Whyte, and other contributors to AUDIO. Some of these discussions are so interesting that we might well publish them in these pages—uncensored, of course.

I heard an interesting story from John Woram recently. John is now studio manager for Vanguard Records and he visited Moscow some months ago. It seems he was walking in Red Square when he was accosted by a stranger who said, "Aren't you John Woram?" John said, "Yes, but how . . . ?" "Ah," replied the stranger. "I thought I recognized you. Your photograph was in AUDIO magazine." It was indeed—two years ago, May, 1969 to be exact. A tall story but John swears on a stack of Pravdas that it's true! Anyway, he is now working on another article for us so perhaps when John next visits Moscow he will find a delegation waiting. . . .

The New York Audio Society

The above Society is pleased to announce that Mr. Henry Akiya of the Sony Corporation of America will demonstrate the new Sony-CBS SQ quadraphonic disc system at the next meeting on November 17. The meeting will be held at the usual place: the Dragon Seed Restaurant, 95-11 37th Ave., Jackson Heights, New York at 8:00 p.m.

AES Convention

Don't forget the AES Convention October 5th to 8th at the Hotel New Yorker, 34th Street at Eighth Avenue, New York City.

If you're interested in electronic music, you'll probably enjoy *Synthesis,* which is a new electronic music quarterly, which is offering subscriptions at $6.00 annually. Address is 1315 Fourth St., S.E., Minneapolis, Minn. 55414.

Some years ago, a rather unusual speaker system achieved a certain brief popularity in England—partly due to the credibility of a reporter (probably drunk at the time) who wrote a rapturous article full of superlatives for a Most Prestigious Newspaper. The enclosure was a fairly normal kind of corner horn with an upward-facing speaker (costing all of $2.50) aimed at a reflecting lid. According to the proud inventor—the owner of a bicycle store—the secret of the system hinged (sorry!) on the lid which should be wide-open for Wagner with calibration points downwards for Brahms and so on. Anyway, success was short-lived and it was not very long before the sad but no doubt wiser inventor was back again among the tires and inner tubes. But he is not completely forgotten though and every so often I am reminded of his fabulous speaker when I read about wonderful new systems using vibrating baffles, special transducing elements or brand new acoustic principles—which turn out to be almost as old as cigarstore Indians. For some inexplicable reason, most of these exotic new inventions come from Los Angeles—or in that vicinity. It must be the climate! *G.W.T.*

(Continued from page 14)

than necessary, whilst a high tripping level may affect brilliance and audible "breathing" may be apparent. (2) Lower frequencies do not mask noise sufficiently, and switching current should be obtained by sampling the higher audio frequencies only. When low frequencies are allowed to trip the suppressor, an irritating kind of modulation noise will result, and when the turnover frequency is too high, again the filter becomes ineffective.

The action of the Philips noise suppressor is as follows: it is a steep low-pass filter in the absence of high signal frequencies, and it is tripped by high-frequencies only, in such a way that the presence of HF signals above a certain level will bypass the filter action.

The circuit description shows that in the signal splitter the input signal Vi (including hiss) is divided into two parts, V_1 and V_2. The path of V_1 contains an all-pass filter. V_2 is fed through a high-pass filter, an amplifier to obtain a favourable processing level, a continuously variable attenuator and a fixed attenuator to re-establish unity gain. The attenuation rate of the variable attenuator is made dependent upon the level of the HF signal at its input.

For signals above 4 kHz and more than 38 dB below reference level, the signals in the two channels are equal but of opposite phase and cancel each other in the adding stage. It is here that noise becomes noticeable and signals below this level are progressively suppressed, together with the noise.

Low frequency signals and signals with an amplitude of more than -38 dB below reference level are not present in the output of the attenuator stage. Thus there is no cancelling action and Vo is wholly linear. Unweighted measurements show a ratio improvement of more than 10 dB at 6 kHz and 20 dB at 10 kHz. For high frequencies the circuit causes a phase-retard of 180° which largely compensates the phase-lead caused by the equalization circuits of tape recorders. As a result the overall transient response is significantly improved, Philips' designers report. The system is switchable in/out. Equipment incorporating this device is not yet available, as we write, but may be available by the end of this year. The cost to include in recorders, etc. will not be expensive.

* * *

AUDIO readers will know that the world-wide Dolby "noise-stretching" techniques have already been adopted by some 400 recording companies, motion picture studios and broadcasting organizations. Just announced is an IC version of the Dolby B type (in conjunction with Signetics) which should have considerable impact on the cassette player market, as well as having applications in hi-fi FM broadcasting. Dr. Ray Dolby's design and development team is located in his company's laboratories in Clapham, southwest London. Bert Whyte dealt with the application of the Dolby B technique in the June, 1971 AUDIO.

* * *

Ferrograph is a very well respected name in England and we have just learned that a licensing agreement has been reached between Ferrograph and Dolby Laboratories, Inc. to fit the B noise reduction system. The general quality of the Ferrograph tape transport, heads, and the electronics are such that when the inherent noise in low-speed recordings is reduced by the use of the Dolby technique, the overall quality of tapes made at 1⅞ ips is then comparable to that produced at 7½ ips without the system. Another Ferrograph product which we are now testing—I do not know whether it is available in the USA yet—is the RTS1 Recorder Test Set. Consisting of 4 basic sections, variable frequency audio generator, millivoltmeter, peak-to-peak wow and flutter meter, and distortion measuring network, this all-in-one instrument will measure frequency response, distortion, crosstalk, erasure, input sensitivity, output power and S/N ratio.

* * *

Arthur Radford, eminent British designer of audio amplifiers and loudspeakers, recently demonstrated his latest SPA 50 power amplifier and advanced control unit (Model SC 24) at the Sonex exhibition at Skyway Hotel, Heathrow Airport, complemented by an FM stereo tuner FMT4 incorporating some sophisticated circuitry. But these developments form only a few of the developments that Arthur is working on at present.

His Model 270 loudspeaker is of interest to devotees of the all-round type of loudspeaker dispersion, as although it is not a true omni-directional, since the middle and upper frequency range units are forward facing on each of three sides, so covering 270°, hence its name, but it does radiate an uncolored sound, if not quite such a positive stereo image as some listeners prefer, when used as a pair. I can reveal that a 360° design of an unusual nature and physical construction is under development, which I'm sure will cause quite a stir in the audio dovecotes when released at the end of 1971, I expect. Æ

On Matrix Quadraphonic Systems

E-V Stereo-4 Decoder

Leonard Feldman

AFTER THE INITIAL FLURRY of excitement and, regrettably, the misinformation engendered by the sudden interest in quadraphony, some ordered definitions seem to have evolved in this new listening medium. Readers who have followed the rapid progress of four-channel sound are aware that there is such a thing as "discrete four-channel sound" and something else called "matrixed four-channel sound." In the former category are to be found such source materials as four-channel tapes which require a tape playback unit equipped with a four-track head, four separate preamplifiers, four amplifiers and four loudspeakers. A second source of program material is the much heralded JVC four-channel disc which was successfully demonstrated more than a year ago. This disc, as first demonstrated, had grooves which included the ordinary 45-45 (or lateral-vertical) cutting system for the left-front and right-front channels. In addition, a supersonic subcarrier frequency, modulated with left-rear and right-rear information was also inscribed in the groove. While a subcarrier decoder would be required to recover all four channels as independent program sources, the JVC system nevertheless qualified as a "discrete" four-channel system in that the interaction between channels was no greater than the limitations normally imposed by the separation capabilities of the cartridge, associated electronics, etc. There are difficulties inherent in the JVC disc, including problems of tracking (by low-cost cartridges), playing time per disc side, destruction of the high frequency subcarrier content by worn styli and the like, but all of these do not alter the fact that the JVC disc was, and is, a possible source of discrete four-channel programming—second only to tape in an open reel or cartridge format.

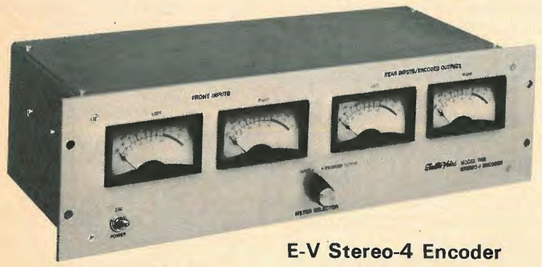
We shall be concerned here not with the discrete form of four-channel sound reproduction, but with the so-called matrix forms, their underlying principles, their advantages, and their limitations. Basically, "matrixed" four-channel stereo has come to mean the mathematical combination of four separate channels of information into two more complex, processed channels. In a way, the listener equipped with a monophonic FM receiver tuned to a stereo broadcast hears a "matrixed" signal as well. In that case, the "matrix" simply consists of the algebraic addition of the left and right channel signals to produce a monophonic composite of the stereo program. That is, the monophonic listener hears L + R (left plus right), while the listener equipped with suitable stereo FM receiving equipment hears separate L and R signals. It is this aspect of stereophonic FM transmission which earns FCC approval of the system as compatible.

In the case of quadraphonic sound, we are dealing with *four* original signals and any attempt at matrixing should fulfill at least two requirements. First, the material should in its two-channel encoded or matrixed form provide a satisfactory listening experience for the listener equipped with two-channel stereophonic equipment. Secondly, the listener equipped with only monophonic equipment should, if possible, hear some sort of composite of the entire original program. Both of these requirements must be fulfilled in the *encoding* process, rather than in the decoding process, since it is presumed that the stereo and monophonic listeners do not wish to add any equipment to their setups. The sole purpose of the *decoding* process should be to *recreate the aurally perceived effect* that the listener would have enjoyed had he listened to the four-channel material in its original, discrete form. At the moment, there are two predominant reasons for the development of such a "closed-loop" encode-decode matrix system. If in fact a satisfactory and simple matrix formula could be derived, disc recordings could be manufactured in much the same way as they are currently being produced, since the standard cutting apparatus (capable of impressing two channels of information on a disc) could continue to be utilized with no technical changes. Existing cartridges, styli, and electronics at the reproducing end could also remain unchanged, since these devices are required to track and reproduce ordinary two-channel audio information and cannot detect the fact that the new encoded audio information differs in content from that of an ordinary two-channel recording.

With FM still deemed to be the predominent music source for high fidelity home listening, the second justification for a matrixed system for quadraphony arises from the fact that, to date, no one has come up with a means for broadcasting four discrete full fidelity channels of information via a single FM station while abiding by the present standards and regulations governing such broadcasts as set forth by the Federal Communications Commission. The author was privileged to participate in the field tests conducted by the FCC in the late 1950's when standards were being promulgated for stereo FM broadcasting. Those deliberations extended from late 1957 to mid-1961 and, it should be emphasized, the final rules agreed upon required *no* change in bandwidth requirements, station frequency allocations, and the like. Such systems as have been proposed to date for quadraphonic broadcasting via a single station *would* require such major rule changes and are certain to take even more time for deliberations and trials and tests than was true for the relatively simpler transition to two-channel broadcasting. In addition, the systems thus far proposed all envision the *shifting* of subsidiary communications service (SCA, the subcarrier background music service now provided by such firms as Muzak and others) to a higher subcarrier frequency. While this is of no concern to the FM radio listener, it is of very deep concern to vested interests such as Muzak and others, who have sold or leased to subscribers thousands of specially built receivers—each of which would have to be modified or replaced at considerable cost. In view of these facts, my own feeling is that we are not likely to see approval of a new set of standards for quadraphonic transmission for a *minimum* of five years—if then. In this connection, a "matrix" system offers immediate advantages, in that only *two* channels of information need be broadcast, totally consistent with present rules and regulations. Best proof of this is the fact that some 28 FM stations around the country have already begun (or are about to begin) scheduled broadcasts using the "matrix" system developed by the author and Mr. Jon Fixler in cooperation with Electro-Voice, Inc., a division of Gulton Industries.

Matrixing and Synthesis

Before describing various matrix systems, it is important that the reader understand the difference between a *total* matrix system and a synthesizing approach which has led to the appearance of various products on the market. Synthesis of quadraphonic sound simply means taking an existing two-channel source and treating the two signals obtained in any one of a variety of ways. For example, the L and R signals may be fed through a time-delay network, such as mechanical or electronic reverberation devices. The delayed signals may then be fed to a second stereo amplifier and a pair of speakers positioned at the rear of the listening room to provide artificially produced reverberant sound, coming from the rear, heard a fraction of a second later than the primary signals from the front speakers. Such devices are in fact utilized (along with other processing techniques) by Harman-Hardon in their new "quadraphonic processor." Another synthesizing scheme involves the use of random, out-of-phase information which



E-V Stereo-4 Encoder

may or may not be present in a stereo recording. The routing of such out-of-phase information to one or two loudspeakers mounted at the rear of a listening area (as suggested by Dynaco) does, in many cases, provide a sense of "hall ambiance," largely because the reverberant field originally sensed by the two-channel recording setup often involves random, out-of-phase reflected signals from various parts of the hall or auditoriums in which the recording was made. In addition, purposely or inadvertently, one or more microphones in the recording studio mixing setup may be electrically out of phase to produce significant amounts of L-R signal which would be heard at the rear speakers if they are suitably connected. It is, then, technically feasible to deliberately make specific recordings with certain out-of-phase primary instrumentation, but to do so without special precautions would render such recordings incompatible in monophonic playback. Thus, the original Dyna proposal must remain, at best, in the category of "synthesizers" rather than total systems. As such, it is an interesting and inexpensive way to add a third or fourth loudspeaker to a stereophonic installation for the recovery of such random, out-of-phase information as may be present in a particular recording, but it is no substitute for a total system capable of localizing four sound sources in a predictable manner. The same must be said of the popular Sansui four-channel synthesizer which, by manipulating the phase relationships (and, in certain settings of the selector switch, the frequency content) between the two normal stereo channels and the "derived" rear channels, creates various effects akin to the four-channel listening experience.

In the case of Dynaco, it was soon realized that the "diamond" speaker pattern (a front-center speaker, flanked by two speakers at the front right and left, and a single rear speaker) would not gain popular favor, since, in most "discrete" four-channel arrangements speaker placement in the four corners of the room was rapidly becoming the norm. Accordingly, Dyna altered its hookup arrangement to conform to this format and its latest method, as incorporated in the commercially available "Quadaptor," is shown in Fig. 1. In this arrangement, front left and right speakers are connected normally, while the two back speakers are fed varying amounts of L-R and R-L. While this arrangement comes closer to being a true matrix system (providing, of course, that a suitable *encoder* were available for recording and broadcast purposes and providing the present objections to the introduction of "out-of-phase" material on "compatible" records and broadcasts were to be tolerated), it falls short of meeting some of the fundamental objectives of a "total system." Rear separation is non-existent (aurally or measurably) and much of the material heard from the rear speakers actually appears in the front speakers at a *higher level,* so that listener positioning is *extremely* critical.

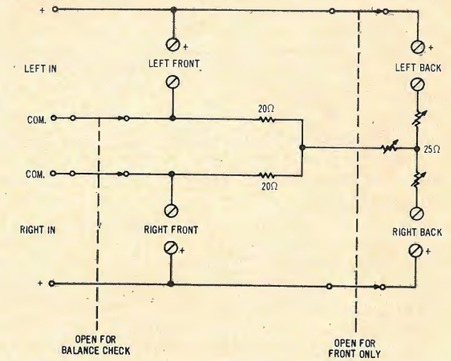


Fig. 1—Circuit diagram of the Dynaco Quadaptor.

Alternative means of making the listener hear sounds from the rear that he does not hear from the front could involve all manner of frequency discrimination. For example, the highs might be rolled-off in the normal L and R channels and the resultant signals passed on to the rear channels in the very simplest frequency-discrimination attempt to create different sounds at front and back locations. Obviously, more sophisticated frequency discrimination schemes suggest themselves, including the use of "comb filters" for screening specific frequencies and then directing them to front and back pairs of speakers. All of these approaches will produce "different" sounds at the rear—but none of them could rightly be called a "closed loop" matrix system.

Electro-Voice System

The Stereo-4 system proposed by Electro-Voice benefits from a series of decisions and acoustic phenomena which were thoroughly explored by its inventors and Electro-Voice prior to finalization of the parameters now used. Listener positioning has been found to be non-critical in that a listener can walk around the room and hear *different* program material from each of the speakers even when he stands close on a given speaker. Excellent front-to-back separation in maintained and, by judicious "blending" of front-left and front-right information (in the case of reproducing two-channel material in "synthesized" four-channel form as well as in the total "encode-decode" process), the "monophonic image" (soloist, center-stage, for

example) remains positively at "front and center" position. A further side benefit particularly related to "classical" recording techniques (but noticeable even in "pop" recordings) arises from the choice of parameters, and I have come to call this side benefit "acoustic matrixing" for want of a more generic term.

Acoustic Matrixing

Readers familiar with presently approved standards for stereo FM broadcasting know that the system may be analyzed in two ways. First, the broadcast system may be thought of as a "switching" technique, in which left and right channel information is alternately "sampled" at a 38-kHz switching rate. A simpler concept (and the one actually spelled out in the FCC rules) describes the system in "matrixing" terms.

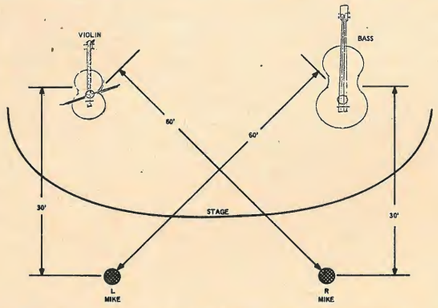


Fig. 2—Typical microphone layout in a classical recording situation. Each mike "hears" the entire orchestra, but from different vantage points.

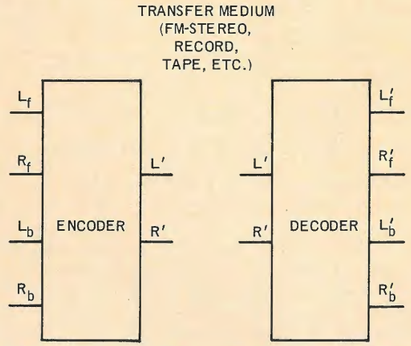


Fig. 3—General format of encode-decode matrix systems.

That is, the main channel is to transmit the sum of L + R, while the subcarrier is modulated with L-R information (a "difference" signal obtained by simply subtracting the R electrical signal from the L electrical signal). Normally, the "decode" matrix for "perfect" stereo recovery at the receiving end involves the following algebraic manipulations: to recover L, we add (L+R) + (L-R) which yields 2L (the factor of 2 denotes amplitude only, and can be ignored in this case or adjusted by simply "turning down" your volume control by 6 dB), while 2R is recovered from the combination of (L+R) - (L-R). Recently, we were experimenting with a stereo FM decoder built along these lines and we fitted it with a variable control which determined the amount of (L-R) or -(L-R) that was to be added in the matrix. We discovered that if, in fact, we introduced *more* than unity of the (L-R) contribution, we actually *heard* greater separation! As an example, if in the matrix we use (L+R) + 1.2(L-R) to recover left and, symmetrically, (L+R) - 1.2(L-R) to recover right, mathematically we come up with 2.2 L - 0.2R for our left recovered signal and 2.2R - 0.2L for our right recovered signal. We found that we could carry this to an even further extreme. For example we might rematrix as follows: (L+R) +2(L+R) and (L+R) - 2(L+R) to yield 3 L-R for our left recovered channel and 3 R-L for our right recovered channel. If you were to observe our recovered left and right signals by means of an oscilloscope, without regard to "phase" or polarity (for, after all, -L is simply L 180 degrees out of phase with itself), you would have to conclude that the decoder was "defective" and that the "separation" was only 10 dB, since you would see about ⅓L in the right presentation and about ⅓R in what you thought should have been exclusively L. *Yet, the audible separation was acknowledged to be better by everybody who listened to the system!* Why? Consider, for a moment, the miking arrangement in a classical, two-channel live recording at a concert hall, as shown in Fig. 2. For argument sake, let us suppose that the mikes are omni-directional and that therefore the acoustic power reaching them from any instrument in the orchestra will be a function only of distance between microphone and instrument in question. The linear distances shown from the violin to either mike and from the bass viol to either mike are not unreasonable, so that *in fact,* the left mike hears not only the violin, but the bass viol as well. Since the bass viol is twice as far from the left mike as is the violin, the mike will hear the bass at a power reduction of 4:1, since sound intensity varies as the *square* of the distance from the source, and the two distances are in the ratio of 2:1. Thus, the L mike might be said to pick up 1.0 violin + 0.25 bass and the R mike hears 1.0 bass +0.25 violin, in terms of acoustic power. Examined from an electrical separation point of view, this represents only 6 dB of separation! In other words, we could say the left channel is really L+0.25R and the right channel is really R+0.25L. If, upon playback of a recording of "matrixed" stereo broadcast we wanted to increase apparent separation, we would only have to apply the "over-matrixing" techniques described earlier–that is, introduce some "negative" L into our recovered L information. Recognizing that L in this instance is really L+0.25R and that R is really R + 0.25L, let us apply these quantities to the two-channel matrix and add in "more than unity" quantities of our L-R portion of the matrix, specifically, 1.25 (L-R). Substituting the actual values for L and R (as they really are picked up by the microphones) we get:

[(L+0.25R)+(R+0.25L)]+1.25[(L+0.25R)-(R+0.25L)]

for the left channel recovery, and

[(L+0.25R)+(R+0.25L)]-1.25[(L+0.25R)-(R+0.25L)]

which, when solved, yield 1.93L + 0.28R for the recovered L channel and 1.93R +0.28L for the recovered R channel. Note that the dematrixed L channel contains approximately only 1/7 of R content and the dematrixed R channel contains only approximately 1/7 of L content. At the performance, recall, each microphone had actually picked up ¼ of undesired channel content, while after dematrixing the undesired content is actually less–down to 1/7. *We have increased apparent and audible separation beyond what it was at the actual performance.* And we have done this by introducing specified amounts of out-of-phase signals from undesired channels!

If you keep thinking about this concept and try to visualize this same thing happening in four channels with the various permutations between left, right, front, rear, and diagonals, you will understand the nature and some of the philosophy behind the particular parameters chosen in the Electro-Voice Stereo-4 matrix system.

Matrixing in General

The basic concept in quadraphonic matrixing is shown in Fig. 3. Obviously, all we can do is mathematically combine L_f, R_f, L_b, and R_b to create two new complete signals, which we shall

call L′ and R′(the encoded signals). The subscripts f and b refer to front and back while capitalized L and R stand for left and right in the following discussions. If we are to have a symmetrical form of encoded matrix and stereophonic and monophonic compatibility dictate that we must, then the encoded signals will have to take the form of $L' = AL_f + BR_f + CL_b + DR_b$ and $R' = BL_f + AR_f + DL_b + CR_b$ in which A, B, C, and D are coefficients which may be *either positive or negative* and which may have an amplitude of anything from 0 to 1. What coefficients to choose as A, B, C, and D is really the problem and the solution is dictated by the series of aural compromises we wish to make, as we shall see presently. As two extremes to consider, let us for example assign values to +1 to all four coefficients. Then the stereo listener would hear exactly the same thing from his right-channel loudspeaker as he did from his left and all stereo effect would be lost. Conversely, if we assign a value of +1 to coefficient A, but 0 to B, C, and D, then the quadraphonic listener would receive L_f from his left speaker and R_f from his right speaker, but he (and we) would have lost all the rear information completely and could not reconstruct the four-channel illusion by subsequent dematrixing. Those are just *two* extreme possibilities and we haven't even considered the fact that A, B, C, and D may take on positive or *negative* (out of phase) values!

Dematrixing in General

Using the general terms developed above for *any* quadraphonic matrix system, we can now consider what we must do, in a general sense, to dematrix or decode the two "combined" signals at the listening end. Let the recovered four channels of signal be labeled L'_f, R'_f, L'_b, and R'_b. The subscripts have the same meaning as before, but the prime (′) notations denote the fact that the recovered signals are not (and never can be) the exact equal of the original discrete four channels of information that we started with. The form of the recovered signals will be (for symmetrical outputs):

$L'_f = EL' + FR'$
$R'_f = FL' + ER'$
$L'_b = GL' + HR'$
$R'_b = HL' + GR'$

in which E, F, G, and H are again new coefficients ranging in value from 0 to 1 and may be either positive or negative in sign. Solving for a typical channel (you can solve for the others yourself) by substitution, we get, for the left-recovered channel:

$L'_f = (EA + FB)L_f + (EB + FA)R_f + (EC + FD)L_b + (ED + FC)R_b$.

Clearly, this solution shows that the recovered L'_f will actually contain *some* amounts of the other three signals (R_f, L_b, and R_b), but the choice of the coefficients and their phase relationships will determine to what extent we aurally *perceive* good quadraphonic "separation" in an actual listening experience.

Scheiber Symmetrical Matrix

Peter Scheiber was first to suggest a practical matrix for encoding and decoding quadraphonic sound—the so-called 4-2-2-4 approach. In addition to the generalized forms of matrixing equations which we have outlined, Scheiber also suggested a gain-riding or sensing approach which, through logical analysis of the predominance of the various signals, could emphasize the "desired" signal from a given speaker when it was the sole or predominant signal present. This latter refinement is fully explained by Scheiber elsewhere. (*) We wish, here, to deal only with the "matrix" aspects of his proposal as they relate to the previously enumerated general equations. For his coefficients, Scheiber chose the following: A = C = E = G = 0.924; B = F = 0.383, and D = H = -0.383. By solving the equations for L'_f, for example, we get:

$L'_f = [(0.924 \times 0.924) + (0.383 \times 0.383)]L_f$
$+ [(0.924 \times 0.383) + (0.383 \times 0.924)]R_f$
$+ [(0.924 \times 0.924) - (0.383 \times 0.383)]L_b$
$+ [(0.924 \times -0.383) + (0.383 \times 0.924)]R_b$
$= L_f + 0.707R_f + 0.707L_b + 0R_b$.

Solution for the other three signals will yield:

$R'_f = R_f + 0.707L_f + 0.707R_b + 0L_b$;
$L'_b = L_b + 0.707L_f - 0.707R_b + 0R_f$, and
$R'_b = R_b + 0.707R_f - 0.707L_b + 0L_f$.

By using symmetrical and equal coefficients in *both* the encode and decode process, Scheiber comes up with recovered signals in which the *measurable* separation between a desired channel and its two flanking channels is 3 dB. Furthermore, this symmetry leads to the complete cancellation of the diagonally-opposite channel with respect to the desired channel. Thus, the right rear disappears entirely when we wish to hear a front left only, but that front left only is flanked by signals coming from the front right and left rear, each attenuated by only 3dB. This is excellent symmetry if one intends to supplement the matrix by means of gain riding (as Scheiber proposes with his elaborate gain control decoder logic circuitry), but is not the best form of assymmetry if one wants to utilize the acoustic matrixing phenomena described earlier. The *absence* of a diagonally opposite channel (which, if polarized out of phase at some nominal amplitude which is less than the coefficient of amplitude available at the desired channel, could have *aided* in the localization effect) is a hindrance, rather than an aid if one wants to keep the system confined to matrixing only.

If one examines the situation with regard to playback of ordinary two-channel discs via these particular coefficients (sans any gain riding), the situation is equally undesirable, for in that instance frontal separation is reduced to a mere 7.6 dB (0.383/0.924 is the Scheiber ratio between desired and undesired information in the left-right relationship of ordinary two-channel playback via this matrix. Of course, Scheiber's system, whether used for playback of his own encoded material or for the "enhancement" of existing two-channel material was always presented together with his gain riding circuitry, and as such was an acceptable format for quadraphonic sound reproduction. The problem with this form of matrix-gain riding combination was the costly nature of the complex gain-riding circuitry which exceeded, by far, the cost of the relatively simple matrix alone. It would seem advantageous, therefore, to replace the totally symmetrical coefficients suggested by Scheiber with an independent set of coefficients for the encoding process and a *different* set of coefficients for the decode process, which are also, of themselves, symmetrical. The objectives set forth for these coefficients are the following:

1. Playback of either an encoded or a two-channel disc via a two-channel reproducing system should provide adequate separation of left and right information so as to preserve the artistic intent of the performers and/or producers of the recording. This requires that the left front and right front discrete separations should be maintained at a figure of at least 10 dB. (The reasons for this arbitrary figure will become clear shortly.) It should be bourne in mind that this 10 dB figure *must* be discrete and measurable in this instance, since with only two channels operating, we cannot avail ourselves of the effects of acoustic matrixing possible in the full four-channel array.

2. In the *monophonic* playback of an *encoded* disc, rear information must continue to be present but may, if necessary, be attenuated to some degree. This requirement is made not only from an aesthetic point of view, but is a very real requirement in the broadcasting of such encoded discs, since at the

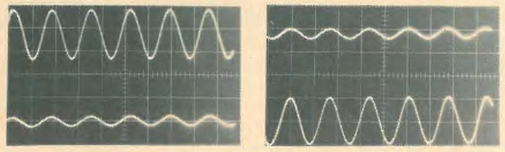
(*) AES Journal, Vol. 19, No. 4; pp. 267-79

outset, a great many listeners will be using monophonic FM receivers. This need parallels the earlier requirement of stereo-mono compatibility which loomed as such a large issue in the earlier FCC deliberations with regard to two-channel stereo broadcasting.

3. Front-to-rear separation, and in particular, *diagonal* front-to-rear separation should be kept at a maximum amount in four-channel playback of encoded discs, making full utilization of the previously discussed acoustic-matrixing effects. It is this characteristic which will provide the desired ambience effects of a concert hall, since it has been shown that a severe blending of these channels tends to destroy the ability to perceive such ambient effects.

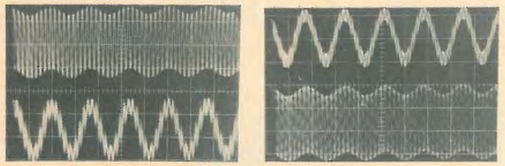
Selecting Coefficients

An extended period of experimentation followed the setting forth of the above requirements, and matrix "black boxes" were built in which each of the coefficients (A, B, C, D, E, F, G, and H) of both the encode and decode process were capable of being varied throughout their range and in which the polarities of the various coefficients could be altered at will. The final coefficients incorporated in the Electro-Voice Stereo-4 system are a result of these experiments and were later confirmed by computer analysis of the criteria desired.



A B

Fig. 4—Left-front and right-front outputs in **A** when signal is fed to L′ input and in **B** when signal is fed to R′ input. Upper trace is LEFT.



A B

Fig. 5—Left-front and right-front outputs of EVX-4 decoder in **A** when L′ input is high frequency tone and R′ is low frequency and in **B** when outputs are reversed. Upper trace is LEFT.

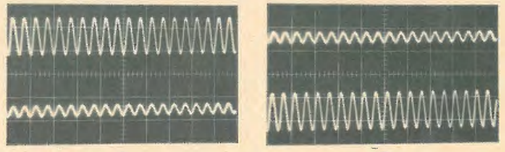
It is interesting to note that the results obtained from the computer matched the results obtained empirically exactly and that the only additional adjustments required were those necessary to insure "unity" gain at each channel's output to correspond with the power levels present in the original discrete four-channel program source.

The exact coefficients used in the Electro-Voice encoder and decoder, as currently marketed, are A = C = E = G = +1.0; B = +0.3; D = -0.5; F = +0.2, and H = -0.8.

When these coefficients are substituted in the general matrixing formulas developed earlier, certain general statements can be made regarding the measured performance of the EVX-4 decoder which is now available for use in home quadraphonic systems. First, the left-front and right-front outputs have undergone a partial "blending." This tends to stabilize the localization of any desired "monophonic image" (such as a "stage center" vocalist, etc.) in playback.

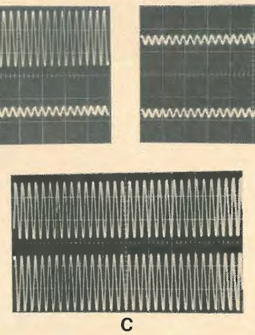
Figure 4A is a scope photo of the left-front and right-front outputs of the EVX-4 decoder with a left-only or L′ signal applied at 400 Hz. The upper trace in this and all subsequent photos represents LEFT while the lower traces represent RIGHT. The measured separation is a bit more than 14 dB (more than fulfilling requirement 1 above). In Fig. 4B we see the reverse situation, in that an R′ signal of 400 Hz is applied to the decoder and the L′$_f$ and R′$_f$ signal outputs are viewed. The two conditions are perfectly symmetrical, in that observed separation is the same in Fig. 4B as in Fig. 4A. In Figs. 5A and 5B we examine the two frontal outputs when different L′ and R′ signals are fed into the decoder. In Fig. 5A the L′ signal is 6 kHz, while the R′ signal is 400 Hz, while in Fig. 5B the conditions of input are reversed. Again, symmetry is observed, as well as the slight "blending" of the front outputs.

'Scope photos of the rear outputs are not as easy to interpret, since phase relationships play a significant part in their efficacy, but several combinations are displayed as a matter of interest.



A B

Fig. 6—In **A** L_f and R_b outputs from E-V decoder with R′ signal only applied; in **B** L_b and R_f outputs from E-V decoder with L′signal only applied. Upper trace is LEFT.



A B C

Fig. 7—In **A** L_f is the upper trace and L_b the lower; In **B** L_b is the upper trace and R_b the lower, and in **C** L_f is the upper trace and R_f the lower. All are with a mono (L_f = R_f) signal applied.

In Fig. 6A we see the resultant outputs at L_f and R_b when a signal is applied to R′ only, while in Fig. 6B outputs R_f and L_b are observed with an L′ signal only applied. In both cases observed separation of these diagonal images is approximately 17 dB. Figures 7A and 7B show what happens when a *monophonic* signal is applied to the decoder (L′ = R′). In Fig. 7A we examine the relationship between the L_f and L_b outputs and note that the output at the rear is down over 18 dB compared to the front, while Fig. 7B shows that *both* back outputs are down by the same large figure of attenuation with respect to the frontal outputs, which are equal in amplitude as shown in Fig. 7C.

How Much Separation

Invariably, whenever we demonstrate the E-V Stereo 4 system to an audience, there is always someone who asks the inevitable question, after first assuring us that he does indeed hear four separate channels, "How much separation are you actually getting?" If you have followed our analysis to this

point, you will understand, as we continue to insist, that simply quoting numbers of electrically measured dB will not constitute a complete answer to the question. Recall particularly the situation described earlier, applicable to "classical" two-microphone recording, and you will realize that even if the two-channel medium were capable of 40 or 50 dB of channel separation, the resultant recording would contain no more than 6 dB of separation in the true, aural sense.

Often however this explanation is countered by the "ping-pong purist" who admits that we have correctly analyzed the situation with respect to "classical" recording, but have not taken into account the effects obtainable in "studio mixing" or "pop" recordings, where as many as 16 separate microphone pickups (often totally isolated from each other in space—and even in *time*) offer possibilities for "infinite" separation between two or even four channels of the finished recording. Well, just what do we mean by "separation" anyway? Isn't the end goal of multi-channel audio the ability of the listener to localize or "pin-point" the source of a given sound? If so, just how much "separation" is required to do this? We conducted a series of experiments with several listeners who were asked to point to the "image" of a piano in a solo recording played on regular two-channel equipment. Distance between speakers was 12 feet and we played the material *monophonically,* adjusting levels of left and right speakers with respect to each other.

In the first series of experiments, both speakers were connected in phase. The average results are plotted in Fig. 8. As might be expected, when equal level was fed to both speakers, "image" was correctly pin-pointed exactly between the two speakers—dead ahead. As we began to increase the intensity of the right speaker (and lower the intensity of the left one), listeners' fingers began to point to the right, reaching virtually the corner of the room when the intensity difference between the two sources reached 6.0 dB. *Further increase of difference between speaker intensities resulted in almost stationary pointed fingers!* Just to make certain of our results, we reversed the procedure, gradually increasing the intensity of sound heard from the *left* speaker while simultaneously decreasing the sound intensity from the right speaker. "Pointing fingers" came to final rest when the *difference* in sound levels reached 6.5 dB this time. Our only explanation for the difference in results is the possible difference in the acoustic characteristics of the two sides of the listening room. To be on the safe side, let's take the higher number and conclude that full localization can be realized by most listeners when the sound emanating from the desired channel is 6.5 dB greater than the sound coming from the undesired channel, in a two-channel array. This should really come as no surprise, for if it were not true, the classical two-microphone recording technique could not yield the near perfect localization that it does! (Admittedly, small time delays enter the picture too and undoubtedly aid in the localization process, but in our opinion they are of less importance than level differences.)

Our next series of experiments was prompted by a phenomenon familiar to everyone who has ever listened to stereo speakers connected out of phase. In attempting to localize sound "between" a pair of out-of-phase speakers you have undoubtedly experienced that sense of "vagueness" or confusion which hints that something is "wrong" somewhere. Slight movements of your head cause the apparent source of sound to "shift" rapidly and you have difficulty really "pointing" to the "drifting image." Since, in the E-V Stereo 4 system many out-of-phase inter-relationships exist between pairs of channels, diagonally and in the rear, we repeated our earlier experiments, this time with the pair of speakers out of phase. To make the experiment more interesting and more meaningful in terms of the E-V system, we positioned the listeners so that the two speakers were *behind them.* We asked each listener to indicate by pointing over either shoulder as to where he thought the sound was coming from. The results are shown in Fig. 9. Notice that when the level of intensity of the desired speaker in the out-of phase pair is only 1 dB greater than that of the undesired channel, there is "instant" identification of the general direction of the source of the sound. Again, the experiment was repeated for the opposite channel of the pair and the results, this time, were identical.

The above experiments would tend to confirm that localization of sound *does not* require the orders of electrical separation which we have thought necessary in the past. In particular, if we are to adopt a matrix approach to multi-channel sound reproduction in the home, it should be based on its ability to recreate the listening experience which exists in the live performance or in the mind of the artistic director of the recording session—and not on meaningless or arbitrary dB figures obtained with meters, 'scopes, and static sine-wave testing. Æ

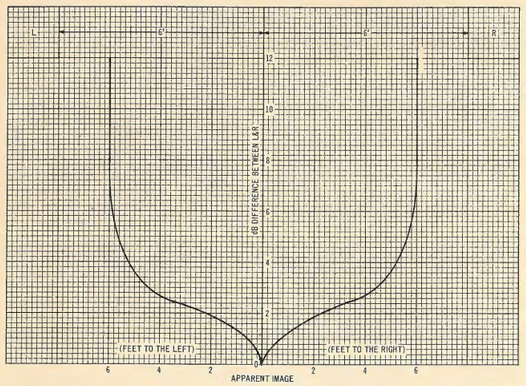


Fig. 8—Level difference vs. apparent location of two in-phase speakers.

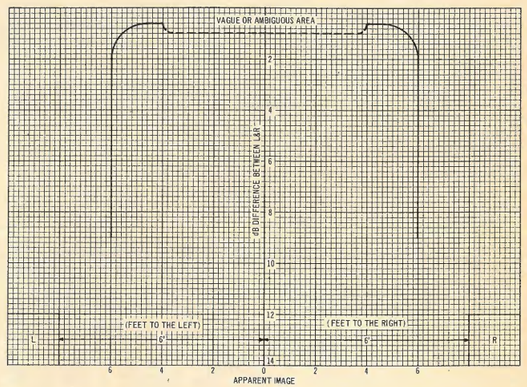


Fig. 9—Level difference vs. apparent location of two out-of-phase speakers placed behind the listeners.

One Approach to Four-Channel Sound—

Dynaco/Gately

Dr. Craig Stark*

Dynaco Quadaptor

THE SO-CALLED "matrix-process," like the science of engineering, is essentially a compromise, a judicious balancing of one benefit (a particular performance capability) against another (cost). In a word, what matrixing does is to trade *unneeded* amounts of channel separation (left-front to right-front, right-front to right-rear, etc.) for the ability to recover not only hall ambience but a significant degree of the directional potential of four utterly discrete channels *without* rendering our existing equipment unusable. By deliberately manipulating phase and amplitude from four different sources, we can encode two-channel LP, tape, or FM broadcast. The matrix technique, indeed, is the only four-channel approach which can at present be applied to all program sources. The owner of ordinary stereo or mono equipment isn't even aware of the encoding. But if the listener has the needed *decoder,* he can recover controlled and predictable four-channel results.

At present there are two complete encode-decode systems available on an off-the-shelf, production-line basis. Dynaco and Gately Electronics cooperated to produce one, Electro-Voice and Audio Designs collaborated to manufacture the other. As the E-V "Stereo-4" system is discussed elsewhere in this issue, as are two other matrix systems from CBS and Sansui, I'll be more concerned with the Dynaco/Gately approach.

(The Sansui system is available and is in use by a number of broadcasting stations.—Ed.)

Fortunately, the first point to be made is that *these two existing total matrix systems are compatible with each other.* A recording processed by the Gately QE-1 quadraphonic encoder can be decoded by any of the various Electro-Voice-licensed home units; we'll see why shortly. Similarly, Dynaco's Quadaptor playback unit is recommended by *its* manufacturer for use with all "Stereo-4" encoded material.

In order to understand how the whole encode/decode matrixing process works, let's start with the overlaid patterns shown in Fig. 1. (I've used the now-conventional lettering, though differentiating between "right-front" and "center-rear" by merely capitalizing the "B" in the latter case invites confusion.) These patterns, which, if one of them is shifted by 45° become superimposed, may be looked at from two *very* different perspectives. On the one hand they could be seen as approximate playback speaker locations in our listening rooms. Contrariwise, one might view them as at least rough indications for microphone placement at a "live" recording session. One's natural impulse—until you stop to think it through—is that these should be the same, so that if a recording was encoded on the diamond pattern we should have to decode it by putting our "front" speaker in the fireplace and our "back" speaker behind the couch.

Fortunately, this is nonsense, for while the Gately encoder permits the recording engineer to select either a square or a diamond-shaped *encoding* pattern, that choice does *not* dictate the placement configuration of our playback speakers, nor, for that matter, does it affect *our* choice between the E-V or the Dynaco *decoding* systems. To see why this is so, all we have to do is to compare the actual encoding formulas used to encode quadraphonic information by the Gately/Dynaquad and by the Electro-Voice Stereo-4 techniques. So, using the lettering of Fig. 1, here they are:

Gately QE-1, switch set in square position:
Left encoded output: a + 0.25b + c -0.5d
Right encoded output: 0.25a + b -0.5c + d
Electro-Voice Stereo-4 (square only):
Left encoded output: a + 0.3b + c -0.5d
Right encoded output: 0.3a + b -0.5c + d
Gately QE-1, switch set in diamond position and microphones set in the four corners:
Left encoded output: a + 0.5b + c -0.5d
Right encoded output: 0.5a + b -0.5c + d

It takes no mathematician, of course, to see how close are the similarities in these formulas. Comparing the Gately and the Electro-Voice squares the coefficient difference is 0.05—probably less than the tolerance of the resistors used in the input matrixes! Clearly, too, "a + 0.25b" means that on the

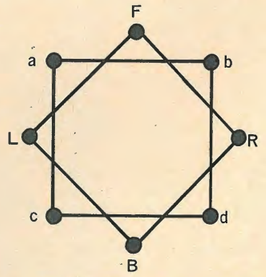


Fig. 1—Speaker relationships of "diamond" and "square" matrixing patterns.

Fig. 2—Gately Electronics' quadraphonic encoder Model QE-1.

*Gately Electronics

encoded left-front to right-front, channel separation is 12 dB, exactly what will be reproduced if we don't decode at all, which is, of course, the situation of the ordinary stereo listener. Paradoxically, the recurring "-0.5d" in the formulas does not really mean that we are subtracting the output of the "d" microphone from the contribution of the other three. It means only that the "d" signal is out of phase with the others; the 0.5 means that relative to the "a" or "c" signal strength, the "d" output is 6 dB lower.

Presenting the QE-1 diamond encoding pattern in terms of the 4-corner, a, b, c, and d microphone locations is somewhat misleading. It appears as if what we conventionally think of as "left/right" separation was being reduced to 6 dB (a + 0.5b) when, by throwing the switch into the square configuration we could keep 12 dB (a + 0.25b). Stated in terms of its own lettering diagram in Fig. 1 (a more realistic indication of the placement pattern with which it would be used), the diamond outputs are actually:

Left encoded output: L + F + B
Right encoded output: R + F - B

Here, of course, "left/right" separation is total. The encoding formula I gave earlier redefines the diamond into a square by assuming that F = a + b, L = a + c, R = b + d, and B = c-d. The relative merits and demerits of encoding in the optional diamond pattern provided by the QE-1 will be evident when we see what happens to the encoded signals later.

Except for the very advanced amateur recordist, of course, the entire matrix encoding process lies solely within the province of the professional: the broadcaster or producer of LP's and prerecorded tapes who desires to build quadraphonic information into its normal studio product. The Gately QE-1, therefore, is expressly designed for the studio, from its Cannon XLR connectors to its ability to drive 600 ohm loads at levels up to +24 dBm. But a look into its optional "extras" may give

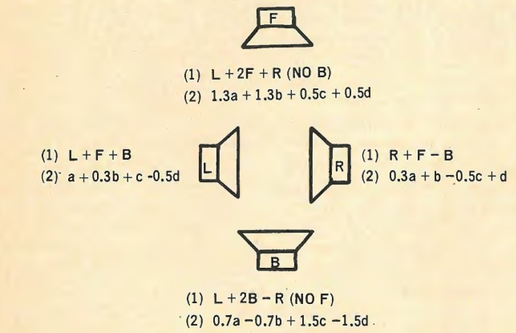


Fig. 3—Dynaco diamond decode, net results: (1) Gately diamond encode, (2) E-V square encode.

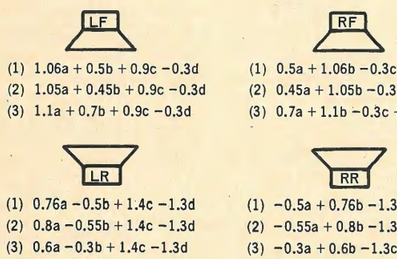


Fig. 4—E-V decoding, net results: (1) E-V square encoding, (2) Gately square encoding, and (3) Gately diamond encoding.

some of us audiophiles an insight into what it is that the pros pay for. The transformerless version "A" pictured in Fig. 2, for example, carries a basic price of only $249.00; version "B," with built-in 600-ohm balanced line output transformers, goes for $299.00. Those studios partial to transformer-coupled inputs will simply remove the dummy plugs provided on the back panel and replace them with standard Ampex plug-in units (either matching or bridging), at a cost of about $80.00. And, if it's desired to monitor the input signal levels at the encoder itself rather than at the recording console, an accessory matching panel with four VU meters is available for $250.00. Adding all these optional features together, we've gone all the way from $249.00 to $629.00! That's quite a jump just for studio transformers and meters, but professional equipment isn't cheap: The E-V encoder lists for $795.00.

A complete schematic diagram of the QE-1 encoder and a lengthy circuit analysis would be out of place, but the basic unit is built around four integrated circuit operation amplifiers, whose use in a wide variety of audio applications was discussed by Mr. Gately ("The Wonderful World of Integrated Circuits") in the June, 1970 AUDIO*.

Essential though encoding systems are to matrixed quadraphony, however, most of our primary interest centers in what happens when we *decode* the signals and feed them to our speakers. Here the approaches taken by the two total matrix systems diverge more sharply, though they all *work* and on each other's encoded material.

For example, take the very simplest decoding approach, the original Hafler diamond speaker placement. True, it doesn't fit the geometry of very many of our living rooms, and it assumes, too, that we are all using Dynaco amplifiers with their "blend" facility. On the other hand, it requires neither a second stereo amplifier nor even any sort of "quadraphonic adaptor." The basic decoding formula for this approach is that speaker F receives $L_e + R_e$. The left speaker gets L_e alone, and correspondingly the right speaker reproduces only R_e. The back speaker is fed with $L_e - R_e$ (The "e" subscripts simply remind us that it is the *encoded* left and right signals with which we are dealing. The other lettering is the same as in Fig. 1).

What happens when we put the Gately-encoded diamond and the Stereo-4 encoded square into this dematrixing network of speakers is a straight question of algebra, and the results are summarized in Fig. 3. Obviously we get terrific results with the total diamond encoding/decoding approach: left to right side separation is complete, as is center front to back. Nor, however, are we very badly off decoding the E-V square on the diamond configuration. A 0.3:1 ratio for left/right gives us a bit more than 10 dB there, and we get anywhere from about 6 to a little over 8 dB of suppression of unwanted front and back signals from the speakers where we don't want them. Too bad our listening rooms aren't often built like Dave Hafler's!

When we turn to the more familiar 4-square speaker placement (with attendant decoding systems), the differences between the E-V and the Dynaco approaches become more marked. The most obvious one is that the Electro-Voice technique uses two stereo amplifiers, while the Dynaco Quadaptor gets along with the one we already have. An integrated circuit within the Stereo-4 decoder splits the two encoded inputs into four separate preamp-level signals (hence the need for four power-amplifying channels), according to the following formula:

Left-Front = $L_e + 0.2R_e$
Right-Front = $R_e + 0.2L_e$
Left-Rear = $L_e - 0.8R_e$
Right-Rear = $R_e - 0.8L_e$

Figure 4 now summarizes the algebra and indicates what each of the speakers reproduces when fed (1) with the Stereo-

*See also, by the same author, "I.C.'s, The Coming Revolution," *db*, September, 1970.

4 encoded square, (2) with the Gately encoded square, and (3) with the Gately/Dynaco encoded diamond. Readers interested in playing with logarithms can calculate the exact separation values, but even at a glance two things stand out.

First, and perhaps most striking, the process of decoding the front two channels has sizably *decreased* LF to RF separation. E-V square encoding had left us with a little over 10 dB between "a" and "b" components, and the corresponding Gately pattern gave us 12 dB. But after *decoding*, the ratio of "a" and "b" mixed together in the front speakers barely exceeds 2:1, so we're now down to somewhere between 6 and 7 dB! That *may* be enough for most listening situations, though in many there is likely to be a narrowing of the stage-wide panorama of sound. (The diamond pattern, which had more of a front-center orientation to start, does correspondingly worse, being reduced to about 4 dB LF to RF).

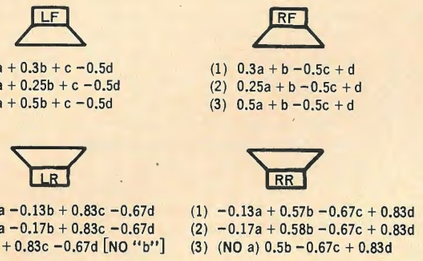


Fig. 5—Quadaptor decoding, net results: (1) E-V square encoding, (2) Gately square encoding, and (3) Gately diamond encoding.

The second thing to observe is that the "c" and "d" components in the LR and RR speakers are almost identical in strength, though opposite in phase. They *are* a good deal stronger than the "a" and "b" contributions in those back speakers, however (particularly in the diamond), and so will tend to mask these sounds out. This gives us good rear projection, especially useful in reproducing reverberation. On the other hand, precise acoustic localization of a pure "c" soloist, for example, is going to be impossible. If the "c" components in the LR speaker (where they should be) and in the RR speaker (where they shouldn't) were in phase and we sat rather toward the rear of the room, "c" would seem to originate from the center rear. That would represent zero separation. Since they are out of phase, however, a certain ambiguity arises as to just where "c" is behind us. The presence of a strong "c" component in the LF speaker helps "pull" the source somewhat to the left, but exact pin-pointing is simply not feasible. The matrix has given us a front-to-back dimension; it's just *where* in the back that we get a bit uncertain.

Let's turn, then, to the other 4-square decoding approach, the Dynaco Quadaptor. The first, and momentarily startling thing about it is that it doesn't decode the LF and LR signals at all! Stopping to think about it, though, why should we? We've just seen that when we decoded the front channels we lost a good deal of the separation present in the encoded signal. Further, by not dematrixing the front, we won't interfere with *whatever* separation might have been present in a non-encoded recording.

What, however, do we do about the rear? We could use electronic decoding, but this would require a second power amplifier, and if the back speakers *themselves* can do the job, together with a simple passive device (the Quadaptor, whose circuit is shown elsewhere in this issue), we save an additional expense. This simplicity, however, has its own cost. The volume level which emerges from the rear speakers will not be as high as that coming from the front unless there is a rear-located source of equal amplitude. How serious a problem is this?

Anyone who has experimented with 4-channel sound in any of its three forms—discrete, matrixed, or simply ambience recovery—knows that *where* you sit on a front-to-back axis is even more critical than on the left-to-right axis. No doubt, quadraphony being new, we'll have special effects records to correspond to the ping-pong games we listened to from table-side when stereo arrived. (I suggest a doubles match with the listener's head at the center of the net.) The fact is, though, that except for the exceptional effect, we want our musicians in front of us, and if the rear speakers get even a little too loud, the special realism they supply is shattered. We can solve this either by changing the volume of the rear speakers or by moving forward slightly. Contrariwise, if the rear speakers are too soft, we can use an amplifier to turn them up, or we can simply move closer to them.

The Quadaptor is based on the premise that we can arrange our listening location within the rear ⅓ of the area bounded by the four speakers. (The rear speakers themselves don't always have to be placed against the back wall, after all). On that assumption we *automatically* compensate for the difference in the signal strength between sounds originating from the front speakers and those emanating from the rear.

Thus, because our assumption is usually justified, here are the decoding formulas used by the Quadaptor:

LF = L_e (no decoding);
RF = R_e (no decoding);
LR = $(2L_e - R_e) \div 3$, and
RR = $(2R_e - L_e) \div 3$.

Again, I have summarized (Fig. 5) the algebraic outputs of the Quadaptor for the three encoding patterns we have been considering. As indicated previously, in this system left-front to left-right separation is a function entirely of the encoder. We can therefore see why a center-back source (L = -R) is as loud through the back speakers as from the front speakers. A diamond encoding pattern yields 6 dB separation in this configuration, i.e. about the same as the encode/decode process of the Stereo-4. On the other hand, it again gives us the least leakage of front originating signals ("a" and "b") into the rear speakers. It thus has some advantage in accenting reverberation and a rear located source; it has also, however, one outstanding drawback. Since $L_e = L + F + B$ and $R_e = R + F - B$, if these two signals are simply combined—as in monophonic reproduction—the back signal disappears entirely. Of course, there is not much hall ambience reproduced in mono anyway, but clearly one wouldn't want to record a soloist in the B position if the LP might be played on a mono FM station!

For the rest, as the proportions in Fig. 5 show, by itself, the Dynaco Quadaptor decoding process seems to have slightly less flexibility, through its inability to let us turn the rear channels up full. It does, however, give us that significant front/rear orientation which a matrix encode/decode should add to the usual LF/RF separation of conventional stereo. We even, indeed, seem to get a very slight (about 2 dB) degree of LR/RR separation, but again, the out-of-phase character of the signals, even aided by the contribution of the appropriate front speaker, makes specific, point-source rear localization impossible.

But do we really need that capability? The discrete 4-channel purist will certainly say "Yes," and his answer has a strong emotional appeal. For 99% of what we want to hear, however, matrixing techniques are the most sensible quadraphonic approach available in the present state of the art. And, as between the two presently existing systems, I suspect it's largely a tempest in an algebraic coefficient. Æ

The Compatible Stereo-Quadraphonic "SQ" Record

CBS/Sony Decoder

Benjamin B. Bauer*

ON JUNE 10th, at Montreux, Switzerland, Columbia Records unveiled its compatible stereo-quadraphonic ("SQ") record before the delegates of the International Music Industry Conference. During the presentation, the SQ demonstration record was played for the delegates in a quadraphonic mode over four loudspeakers placed at the corners of the convention hall. On the record, a narration by David Frost describes the scope of the new development, showing that individual *discrete* channels of sounds emerge *discretely* from the corresponding loudspeakers. Then, after several sample selections, the presentation ends with the grand finale from Tchaikovsky's Fourth. As its final chords were reverberating at the back loudspeakers the audience broke into applause. The succeeding two afternoons were spent by CBS Laboratories engineers demonstrating the SQ records against four-channel master tapes and surprising the delegates with the close match between the two. One delegate even brought his own master tape which was subjected to an A-B encode-decode test, showing that practically any tape can readily be encoded into a decodable SQ record.

Subsequent to the Montreux meeting, others were held in Tokyo, Chicago, Los Angeles, Tanglewood, New York City, and, of course, at our home base in Stamford, Conn., with similar reaction. After every demonstration people ask: How is it that a matrix-based record can so closely equal the master tape? How does it differ from other matrix discs? Will it work with other quadraphonic adapters?

I will try to answer some of these questions but first a brief historical note is of interest. Our entry into four-channel programs was strongly motivated by the experience of John McClure, Director of Columbia Masterworks, who some years ago traveled to St. Marco Cathedral in Venice to record Gabrielli *in situ*. Four centuries previously Gabrielli had positioned his chorus and brass instruments on the four balconies of St. Marco (proof that man's desire to be surrounded with sound is not of recent origin). Four hundred years later, McClure recorded this arrangement on four-channel tape, and, as he recounts, "The sound came from all around spiraling into the dome with unparalleled involvement. Days later I proceeded to edit the tapes for a stereo presentation but the sound fell flat on its face. Gone were the spontaneity and the involvement. Not until I replayed the tapes on four loudspeakers in the corners of the editing room was I able to recreate the St. Marco experience." Since that event, McClure has been a devotee of four-channel recording and reproduction, and we at the Laboratories shifted into high gear to solve the problem of placing these four channels on a compatible record.

Everyone knows that a record groove is a two-channel medium—which means that it is possible to record on it only two "orthogonal," or independent, channels. To be sure, the orthogonality can be chosen in various ways—for example, with 45°/-45°, or lateral-vertical stylus motions, and, as we have discovered during our matrix studies, with clockwise and counter-clockwise circles. The two channels of any orthogonal set one may choose will be independent of each other, but not from another set—some information will be transferred from one set into the other. Such, in essence, is the root of our problem of placing four channels on a disc—how to minimize the effect of this information transfer, and thus to portray a credible four-channel sound display.

Stereo Compatibility

Before describing the SQ record, let us consider briefly the philosophy which must be adopted to produce a truly compatible stereo-quadraphonic system. We take it for granted that such a record must exhibit full frequency response, output level, and freedom from distortion and noise, which characterize the present high fidelity stereo disc, and which precludes the use of carrier systems since they wear so rapidly and take up so much "modulation space."

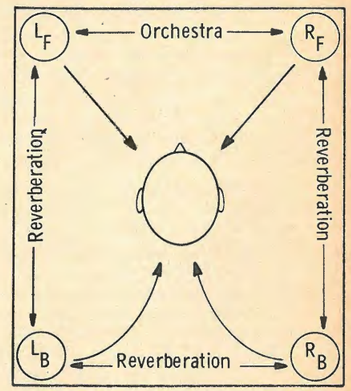


Fig. 1—Typical quadraphonic arrangements. Orchestra spans the front channels with surround sound reverberation; or the performers of a rock group are placed in corner channels L_F, L_B, R_F, and R_B.

For the moment let us return to our initial premise—that the SQ record in the quad mode should produce a sound which for all intents and purposes is the same as that of the original four-channel master tape. But what about the listener who hears the same record on a two-channel stereophonic system? What should be hear?

This question is an extremely important one if we are to attain full compatibility. Suppose a room is equipped with quadraphonic loudspeakers in the corners and you are standing in the center facing in the forward direction. The performance of a symphony orchestra spans the space between the front loudspeakers. The reverberant energy of the hall is reproduced by the whole system including the rear loudspeakers. Or perhaps the performance is a rock quartet with the artists placed in the corners. The general arrangement is shown in Fig. 1. How should we "fold," or transform, this performance from four loudspeakers to two with maximum listener satisfaction?

Before we answer this question we call to the attention of the reader that the sounds from the front loudspeakers in Fig. 1 are shown to follow straight-line arrows, while those from the rear loudspeakers appear to follow a bent path! This is not a physical perturbation, but rather a physiological one which we discovered during our psychoacoustic studies related to quadraphonic reproduction. The fact is that the width of a sound image in the back of us appears to be greatly contracted compared with that which we sense from the front with an identical array of sources. If you have a stereophonic components system you can prove this to yourself with very little difficulty. Stand in the center confronting the stereo loudspeakers while a record with good channel separation is playing and make a mental note of the image width; next, turn around rapidly and you will sense the image to collapse to perhaps ⅓ of its original width! The discovery of this phenomenon, which I call "back image contraction" has played an important role in determining the most propitious way of transforming a quadraphonic performance into one which is fully satisfying artistically in the stereophonic mode.

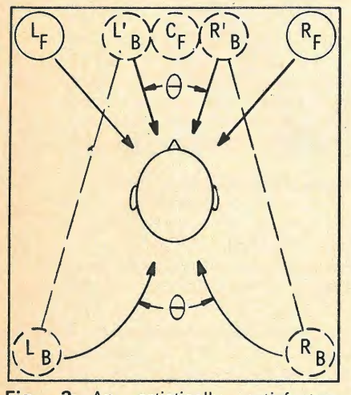


Fig. 2—An artistically satisfactory quadraphonic-to-stereophonic transformation is such that the L_B to R_B quadraphonic channels are transferred to the front channels so as to appear as a reflected sound from an imaginary front wall.

Keeping in mind the above-described experiments, only one method provides a satisfactory quad-to-stereo transformation: the orchestral stage must remain undiminished, i.e. the front channels should stay where they originally had been—in front, spanning the full interspeaker space. Any discrete back channel sounds have to be transferred into the front channels in such a manner that a symmetrically located listener perceives a minimum change in the aspect of sound as a result of the transfer. This latter objective is realized if the sounds originally coming from the rear loudspeakers remain at full strength but are positioned in front as if they had been reflected from the front wall bouncing back toward the listener (as illustrated in Fig. 2). This latter aspect causes them to arrive at the same included angle from the front that they appeared to sustain when they originated from the rear loudspeakers. Any front center signal, C_F, in the quad presentation of course should remain at the center of the stereo display. And if the "reflected" sounds carry with them a feeling of being more distant, a depth illusion is created which helps to provide a quadraphonic identification to the stereo display.

With the quad-to-stereo transformation described above, a symmetrically placed center observer notices the least change when the system is switched from quadraphonic to stereo, and this in itself is proof that a satisfactory "fold" has been achieved. As a matter of fact, the best place from which to observe the impact of quadraphonic sound is *not* at the center of symmetry. One of the virtues of quadraphony is that it frees the listener from the center-of-the-room spot. Its impact is widely distributed over the listening area.

Compatibility Requirements

We can set forth some of the requirements to be expected from a compatible stereo-quadraphonic record and from the playback system on which it is to be reproduced:

1. In the compatible stereo mode the record should exhibit full front-channel separation. This is in accord with the above-described experiments.

2. Since with the quadraphonic capability at hand the producer is able to place the performers everywhere and to "pan" the signals anywhere around a 360° circle, the system should possess *omnidirectional stereo fidelity*; which means that if a constant signal is panned around the encoder, the total sound power delivered to the stereophonic loudspeakers should remain constant regardless of the angle of pan.

3. Upon decoding into four-channels, at least the front pairs of channels should exhibit as complete a channel separation as possible. (Additionally, the greater the channel separation between the other adjacent pairs of channels, the better the quadraphonic illusion.)

4. For the same reason as in 2, above, the system should display *omnidirectional quadraphonic fidelity*, i.e. with a signal panned into the encoder around a 360° angle, the total encoded energy applied to the four loudspeakers should remain constant.

5. Since the signals recorded on the disc will be used to produce an unambiguous quadraphonic performance, there should be no ambiguity in the encoded signal as to direction with a signal panned around the encoder input over a 360° angle; or to put it in reference to the decoder, there should be no ambiguity in the set of decoded signals over the full circle of sound arrival.

6. In principle, the system should be able to handle at least single *discrete* channel sounds *discretely* through the corresponding loudspeakers. This, we will show, requires the use of a suitable electronic logic added to the matrix system. The logic is a rather expensive refinement which has proven to be unnecessary in the majority of home-type reproduction equipments. However, the matrix system should preferably be such that a suitable logic can be used with it.

7. When the matrixed signal is broadcast through an AM station or is played on a monophonic phonograph, all four channels should be transmitted without loss in level. In the case of the rock group it would not do for the back

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performers to drop in level significantly relative to the front ones, thus depriving the listeners of the full measure of performance.

The SQ Record

We can now proceed to describe the SQ record system. Since we have decided to leave the front channel sounds unaltered when changing from quad to stereo, we cause our LF and RF chan-

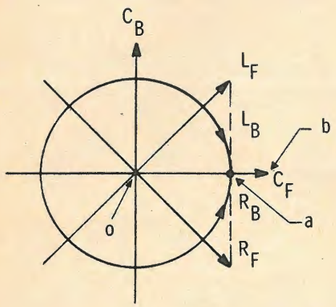


Fig. 3—SQ record modulations.

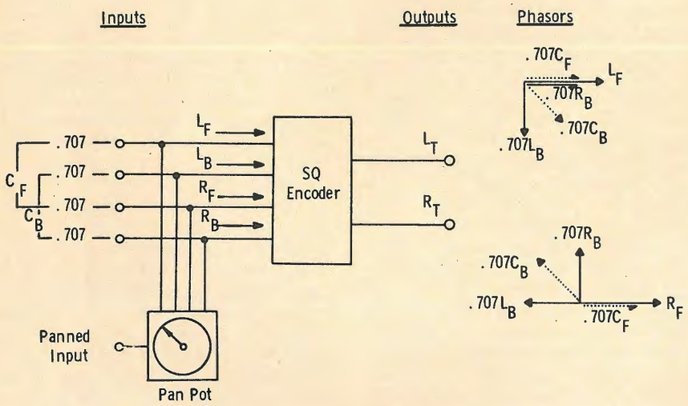


Fig. 5—Encoding the SQ record.

nels to become the Left and Right stereo channels, respectively. This also means that any center-front sound, CF, becomes equal to the Center sound of conventional stereo resulting in lateral modulation.

Next, we have to accommodate the LB and RB channels. During our investigations, we have discovered that two circular stylus motions, namely clockwise and counterclockwise, also form an orthogonal set. It turns out to be favorable to assign to the LB channel the clockwise motion and to the RB channel the counterclockwise motion. The two motions, in combination with the longitudinal motion of the groove create a double helix, which then carries our back channel sounds. When a center-back channel is recorded, the two oppositely directed helixes combine into a vertical modulation. The above-described six cardinal modulations of the SQ record in vector form are shown in Fig. 3, and a microphotograph of a portion of the groove exhibiting the four principal modulations is shown in Fig. 4.

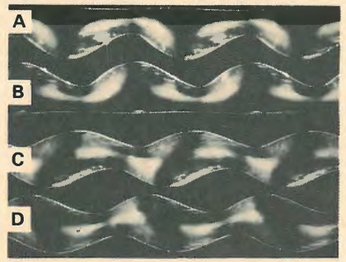


Fig. 4—Microphotograph showing groove modulations of SQ record: **A**, left-front channel; **B**, right-front channel; **C**, left-back channel, and **D**, right-back channel.

The method of encoding an SQ record is shown in Fig. 5. After the recording director has approved the edited version of the master tape which appears on four loudspeakers in the editing room, the corresponding channels, namely LF, RF, LB, and RB, of the master tape are connected to the SQ encoder, resulting in a pair of encoded signals defined by the phasor groups LT and RT. It is noted that LF and RF are precisely in-phase at the output terminals and are completely isolated from each other; that is, there is no LF present in RT, and no RF in LT. Thus, the front-channel separation remains infinite, meeting our first condition for a properly performing stereo-quadraphonic system. The back channels, LB and RB, are in quadrature with the 0.707LB term at LT leading the equivalent term at RT, and the 0.707RB term at RT leading the equivalent term at LT. This quadrature relationship is what provides the circular stylus motion described previously. This quadrature relationship produces an unexpected benefit: Introduced into the stereo loudspeakers they result in an image which is somewhat spread (suggesting distance) and predominantly placed to the left and right, respectively, for LB and RB channels. This is precisely the format for quadraphonic identification in a compatible stereo-quadraphonic display, as prescribed from our previously-mentioned psychoacoustic studies.

At first glance the two phasor groups in Fig. 5 LT and RT appear to exhibit a dissymmetrical phasor orientation. However, a bit of analysis shows at once that in practice this is not the case. In fact, since the signals of the four channels are all different or "incoherent," it is not in the best of orthodox tradition to display them all on the same phasor diagram. We can draw proper conclusions only with respect to phasor relationship between the equally named phasors. The grouping that we use is of principal value in performing mathematical analyses with respect to the SQ system. For example, if a signal is panned around the four channel positions in such manner that its power delivered to the encoder remains constant, we are readily able to calculate the relative voltages and phase positions at the output terminals of the encoder. This operation is best performed on a digital computer, and the readout corresponding to this condition is shown in Table I. It is seen that as the signal is panned around 360 the total stereo power remains precisely constant at a 0 dB level. Thus, our encoding system also meets the second condition prescribed for a satisfactory compatible stereo-quadraphonic record.

Decoding the SQ Record

To decode the SQ record into four signals which correspond to the original four input channels into the encoder, a decoding matrix can be used. Each input signal is modified by two *psi* networks, which are all-pass networks shifting the phase of the signal as a function of frequency without in any way altering its frequency response or output level. The networks in each pair are similar, except that one of the pair provides a basic phase-shift ψ (f), while the other provides a phase shift (ψ + 90°) (f). Networks of this type are commonly used in broadcasting practice to improve the modulation capa-

BEARING (DEGREES)	LEFT TOTAL AMP (VOLT)	PHASE (DEG)	RIGHT TOTAL AMP (VOLT)	PHASE (DEG)	STEREO POWER (DB)
.0	.707	360.0	.707	360.0	—.00
22.5	.383	360.0	.924	360.0	—.00
45.0	.000	360.0	1.000	360.0	.00
67.5	.271	360.0	.963	16.3	—.00
90.0	.500	360.0	.866	35.2	—.00
112.5	.653	360.0	.757	59.5	—.00
135.0	.707	360.0	.707	89.9	—.00
157.5	.707	337.5	.707	112.4	—.00
180.0	.707	315.1	.707	134.9	—.00
202.5	.707	292.6	.707	157.5	—.00
225.0	.707	270.1	.707	180.0	—.00
247.5	.757	300.4	.653	180.0	—.00
270.0	.866	324.8	.500	180.0	—.00
292.5	.963	343.7	.271	180.0	—.00
315.0	1.000	360.0	.000	360.0	.00
337.5	.924	360.0	.383	360.0	—.00
360.0	.707	360.0	.707	360.0	—.00

Table 1—Relative amplitudes and phases of output signals from SQ encoder, and total stereo power level as a function of the bearing angle of "panned" signal.

BEAR (DEG)	T.PR. (DB.)	LFAMP (VOLT)	LFPHA (DEG)	LBAMP (VOLT)	LBPHA (DEG)	RFAMP (VOLT)	RFPHA (DEG)	RBAMP (VOLT)	RBPHA (DEG)
.0	3.0	.707	360.0	.707	135.1	.707	360.0	.707	315.1
22.5	3.0	.383	360.0	.707	157.5	.924	360.0	.707	292.6
45.0	3.0	.000	360.0	.707	180.0	1.000	360.0	.707	270.1
67.5	3.0	.271	360.0	.654	179.9	.963	16.3	.757	300.4
90.0	3.0	.500	360.0	.500	180.0	.866	35.2	.866	324.8
112.5	3.0	.653	360.0	.271	180.0	.757	59.5	.962	343.7
135.0	3.0	.707	360.0	.001	180.0	.707	89.8	1.000	360.0
157.5	3.0	.707	337.6	.381	.0	.707	112.3	.924	.0
180.0	3.0	.707	315.1	.706	.0	.707	134.9	.707	.0
202.5	3.0	.707	292.6	.923	.0	.707	157.4	.383	.0
225.0	3.0	.707	270.2	1.000	.1	.707	180.0	.001	.0
247.5	3.0	.757	300.5	.962	16.4	.653	180.0	.271	.0
270.0	3.0	.866	324.8	.866	35.3	.500	180.0	.500	.0
292.5	3.0	.963	343.7	.757	59.7	.271	180.0	.653	.0
315.0	3.0	1.000	360.0	.707	90.1	.000	360.0	.707	360.0
337.5	3.0	.924	360.0	.707	112.6	.383	360.0	.707	337.5
360.0	3.0	.707	360.0	.707	135.1	.707	360.0	.707	315.1

Table 2—Total power level, relative amplitudes and phases of output signals of SQ decoder as a function of the bearing angle of "panned" signal.

bilities of radio transmitters. The outputs of the *psi* networks are combined linearly with two summing junctions and presented through four isolating amplifiers to the output terminals L′F, L′B, R′F, and R′B, respectively.

We observe the following facts: The principal decoded signals, LF, LB, RB and RF at the output terminals are precisely equal and in phase. This assures that high-fidelity capability is inherent in the decoded signal. We note further, that not only in the front channels, L′F and R′F, are the original signals LF and RF completely isolated from each other, but also that in the back channels, L′F and R′B, the signals LB and RB are completely isolated from each other. This is because the two components of the double helical modulations are orthogonal and become completely isolated after SQ decoding. Thus, in the SQ matrix, both the front and the back channels exhibit total channel separation. This clearly meets the requirements of our condition 3 for stereo-quadraphonic performance.

We can further program our computer to show what happens to the signals of any one decoded channel as well as to calculate the total power in all four channels as a signal is panned around the encoder. The result appears in Table II, demonstrating that the power remains strictly constant during the panning process—therefore, complete omnidirectional quadraphonic fidelity exists, fulfilling condition 4 for high-fidelity stereo-quadraphonic performance.

With respect to unambiguity of directional response, we refer back to Table I and observe that in no sense are the pairs of output signals of the set identical or proportional in their amplitudes and phase angles, demonstrating that condition 5 is applicable. For each position of the panning potentiometer there is a unique set of phasors which characterizes the direction of the output signal from the encoder.

Reproducing Discrete Signals

While there is total channel separation between the front and the back signal pairs, there is transference of signals between the front and back channels. For example, the presence of a front left signal, LF, in its proper channel, also results in two transferred signals of identical amplitude, 0.707 LF, but in a quadrature position in the back channels. This means that in this signal condition there is also infinite separation between the left RF and the RB channels, but only a 3 dB separation between the LF and LB channels. Similar signal relationship can be shown to exist for all the four individual channels.

The front-back channel isolation can be greatly improved by adding an electronic "logic" to the matrix. Such a logic can be described within the scope of this article only in general terms. Thus, if we provide a logic circuit which can detect the presence of equal in-quadrature signals in the front and back channel pairs and equip the decoder outputs with gain control amplifiers, we can cause the circuit to diminish the gain of the channel pairs in which the transferred signals are found and correspondingly to raise the gain of opposite channels so that overall power remains unchanged; and this will leave the primary signal with the correct total power and at its proper loudspeaker only. The action is made rapid enough as to be inaudible and is applicable equally to all four channels. The effect is precisely the same as if there existed four separate lines between the master tape and the loudspeakers.

In practice, however, quadraphonic signals seldom appear in isolation. Instead, there virtually is a constant interplay between the channels. As the sounds from various channels overlap in rapid sequence the action of the logic is less significant because the hearing mechanism becomes too confused to be able to assuredly tell the direction from which a particular sound originates. With simultaneous and complex sound patterns the difference between the master tape and the reproduced matrix sounds becomes imperceptible even with diminution of logic action. Under all the conditions usually encountered, i.e. whether there are isolated discrete sounds or a constant interplay between the channels, the listener almost invariably is unable to

differentiate between the master tape and the reproduced record.

Thus, condition 6 for stereo-quadraphonic reproduction of decoded sound has been met in the SQ record system.

Matrix Decoder Performance

While there is little doubt that the addition of a logic to the matrix produces superior performance, especially with discrete channel sounds, it is also true that with the majority of quadraphonic selections the four channels are operating more or less continuously, thereby justifying the possibility of omitting the logic circuit from quadraphonic reproducers in the moderate price categories. Many engineers and artists who have listened to the SQ system with and without the logic mode have indicated that the latter would be perfectly satisfactory in the majority of applications, even if discrete channels are not reproduced without a measure of dilution. With this qualification it is possible to provide excellent quadraphonic sound even in the most modest home reproducers.

Commercial Apparatus

A typical SQ decoder as for example produced by the Sony Corporation, first CBS licensee in Japan, is shown at the beginning of this article. This decoder works in combination with any components-type stereo phonograph. The stereo output is connected to the decoder, from which four new outputs emerge. Two are plugged back into the existing stereo preamplifier, while the other two are connected through suitable power amplifiers to two additional loudspeakers in the back of the room. A deluxe model with a comprehensive logic also is available.

Broadcasting SQ Encoded Sound

An SQ record or an SQ encoded two-channel tape can be transmitted directly through an FM-multiplex transmitter, being heard in a normal FM-multiplex receiver as conventional stereo. With the addition of a decoder and two loudspeakers to the receiver output, reproduced quadraphonic sound is obtained.

The question arises, what does the listener to an AM broadcast hear? The answer is readily obtained by inspection of Fig. 3. The circular modulation of L_B and R_B channels intersects the horizontal axis at point *a*. The L_F and R_F signals are projected on the axis also falling on *a*, as shown in broken lines. Therefore, the four corner sounds are reproduced at full strength. The center front sound, C_F, is reproduced at a 3 dB higher level as in conventional stereo. The center back sound, C_B, which has a zero projection on the axis disappears unless special recording procedures (outside the scope of this article) are used.

Therefore, while the center back channel is reproduced fully in both the quadraphonic and the stereo modes, we advise our producers not to place soloists at the dead back of the audience.

With the understanding on part of the producer of the capabilities of the SQ system, totally satisfactory monophonic broadcasting and reproduction of SQ program are obtained, thus fulfilling the seventh and last condition set forth in our qualifications of stereo-quadraphonic systems.

Acknowledgment

I wish to acknowledge the tireless collaboration of my colleagues Dan Gravereaux and Art Gust, who have contributed their intelligence, energy, and ideas with full dedication to make the SQ system possible. Also, most importantly, my colleagues at Columbia Records, Clive Davis, John McClure, and Stanley Kavan who provided management and artistic guidance, and especially Bill Bachman of Columbia Records who with his advice, inspiration, and moral support made an enterprise such as this possible. AE

The Sansui QS System

Sansui QS-1 Synthesizer

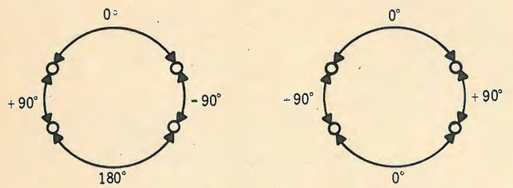


Fig. 1—Phase relationships among four channels.

Fig. 2—The QS-1 creates a complex phase interference fringe, then through phase modulation, produces the same phase movements as are present in a live sound field.

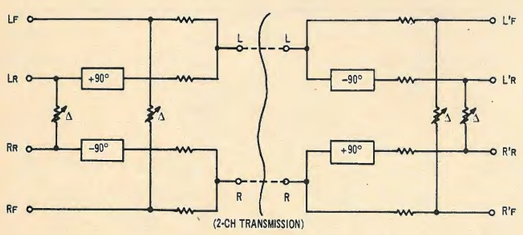
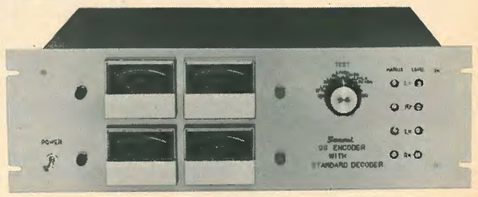


Fig. 3—Block diagram of Sansui QS coding system.



Sansui QS encoder

THE SANSUI QS system is rather similar to the E-V Stereo-4 arrangement but there are some differences which Sansui considers important. First, channel separation is symmetrical at 3 dB (like the Scheiber) which gives a square sound field, and second, the rear channels are processed in a different manner. The encoder phase-shifts left and rear channels by -90 degrees instead of 180 to avoid possible cancellation of the reverse-phase relationships as shown in Fig. 1-A. Figure 1-B shows the phase relationships at the decoder output, and it will be seen that the rear channel phase has not been reversed so that they are now in phase with each other. Sansui claims that this method gives much better localization with a clearer back image. The encoder uses a special phase modulator circuit which, in effect, modulates the rear channels to produce time and frequency differences between the indirect and direct sound components and the nonmodulated direct sound signals. The encoder outputs are:

$$L = L_F + \Delta R_F + L_R\underline{(/+90^\circ)} + \Delta R_R\underline{(/+90^\circ)}$$
$$R = R_F + \Delta L_F - R_R\underline{(/-90^\circ)} - \Delta L_R\underline{(/-90^\circ)}$$

Decoder outputs are:

$$L_F' = L + \Delta R$$
$$= L_F(1 + \Delta^2) + R_F(2\Delta) + L_R(1 - \Delta^2)\ \underline{(/+90^\circ)}$$
$$R_F' = R + \Delta L$$
$$= R_F(1 + \Delta^2) + L_F(2\Delta) + R_R(1 - \Delta^2)\ \underline{(/-90^\circ)}$$
$$L_R' = (L - \Delta R)\ \underline{(/-90^\circ)}$$
$$= L_R(1 + \Delta^2) + R_R(2\Delta) + F_L(1 - \Delta^2)\ \underline{(/-90^\circ)}$$
$$R_R' = (R - \Delta L)\underline{(/+90^\circ)}$$
$$= R_R(1 + \Delta^2) + L_R(2\Delta) + F_R(1 - \Delta^2)\ \underline{(/+90^\circ)}$$

Several FM stations are now using a Sansui encoder on an experimental basis including Chicago's WFMT.

The JVC CD-4 System

JVC CD-4 cartridge

JVC CD-4 Demodulator

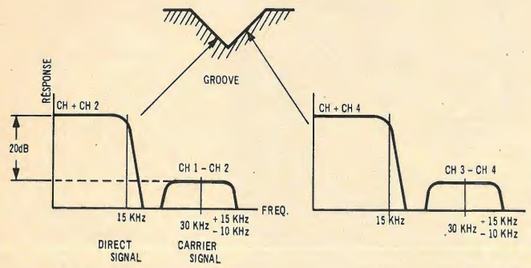


Fig. 1—JVC four-channel system.

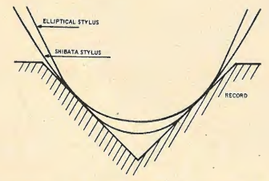


Fig. 2—Comparative front views of Shibata and elliptical styli.

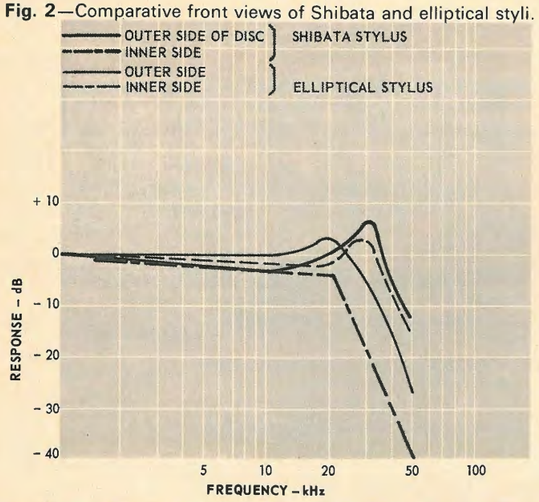


Fig. 3—Frequency response of ordinary stereo cartridge with Shibata and elliptical styli.

THE JVC CD-4 system is not a matrix; it is in fact a multiplex arrangement using a carrier technique. Figure 1 shows the configuration; note that the frequency response of the sum signal is slightly better than that of the difference signal. The carrier modulation is centered on 800 Hz with FM below and phase modulation above that frequency. The CD-4 system is by definition discrete. In other words, in terms of channel separation it is comparable with four-channel tape. Not quite as good, because of phono cartridge crosstalk, but it is certainly better than matrix systems in this respect. Distortion is said to be low with excellent signal to noise.

The disadvantages are A. the wide bandwidth requires a high compliance, wide range phono cartridge capable of working up to at least 45 kHz; B. it is difficult to broadcast, and C. the decoder is complex and therefore expensive. The problem of cartridges is not too serious as JVC has already released one which is relatively inexpensive. Recently they announced a further improvement in the design of the actual stylus, shown in Fig. 2. This new stylus configuration, called Shibata after its inventor, makes better contact with the record grooves than the conventional type. Quite apart from lower tracing distortion, reduced record wear, and better signal/noise, there is another advantage—the higher mechanical resonance. In practical terms this means a wider frequency response and lower cross-talk at the high end. Figure 3 shows the response of an ordinary stereo cartridge with elliptical stylus compared with Shibata stylus. Figure 4 shows the response of a JVC CD-4 cartridge with the two different styli. It is emphasized that the CD-4 cartridge is perfectly compatible and can be used for two-channel stereo or mono.

Turntable speed is reduced from 33⅓ by a ratio of ½.₇ when cutting the record. The MPX signals thus modulate a 11.1 kHz

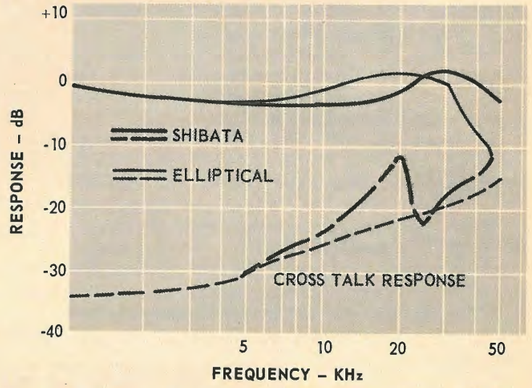


Fig. 4—Frequency response of JVC CD-4 cartridge with Shibata and elliptical styli.

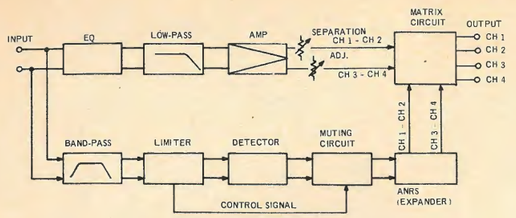


Fig. 5—Demodulator block diagram.

oscillator carrier when recording but in the higher speed playback the carrier becomes 30 kHz. One channel is phase-delayed to reduce crosstalk.

The inherent difficulties in using the JVC system for FM broadcasting can be solved by using a multiplex FM system like the Gerzon(*) or the Dorren and it is understood that experiments are being conducted along those lines. As JVC's Gerald Orbach said, "The two systems were made for each other." But the snag is still the wide bandwidth involved and it would certainly interfere with the SCA background music transmissions which use a high frequency subcarrier. That being so, it would be doubtful whether the FCC will give its blessing to the JVC-Dorren systems just yet—but we could be wrong. As to the complexity of the decoder (see Fig. 5)—really a demodulator—well, it IS a lot more complicated than a matrix but no prices are yet available. It sells in Japan for just over the equivalent of $100.00 but no doubt increased production will bring the price down. At the present time several FM stations in Japan are experimenting with the JVC system and it is known that record companies here have shown more than a little interest.

*Audio, September, 1970.

Summing Up

Utah Studio 4 Ambience Regenerator

Matrix requirements, compatibility--and some recommended records

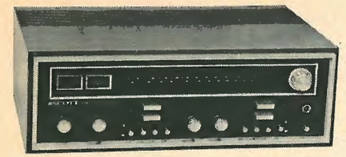
Pioneer QA800 Amplifier

QUADRAPHONIC SOUND on tape presents no particular problems and such tapes are now available for reel-to-reel, 4/8 track, and very soon even cassette players. As far as tape recorders are concerned, there is a great variety of quadraphonic machines from which to choose, ranging from just over $100.00 for a 4/8-track unit to $400.00 and up for reel-to-reel models. There is also a wide choice in four-channel amplifiers and receivers—the latter having provision for plug-in modules so the appropriate decoder can be inserted when standardization and the FCC permit. No, the real difficulty lies in squeezing those four channels on a disc in such a way that it can be played on two-channel or mono equipment and so it can be broadcast without infringing FCC regulations. The simplest way to perform this near-miracle is to use a matrix or coding arrangement and the requirements were admirably set down by Peter Scheiber* as follows:

1. Basic four-channel performance:
   A. The ability to record sounds occurring at any point in 360 degrees and to reproduce each sound from the correct location in playback.
   B. The nondegradation of signal quality, including noise, frequency and nonlinear distortion as consistent with highest standards in the state of the art.
2. Compatibility:
   A. Four-channel compatibility: non-obsolescence of playback equipment.
   B. Stereo compatibility: the ability to reproduce the four-channel program on all standard two-channel stereo equipment, with all sounds in the four-channel program heard in their proper left-right positions.
3. Economy
   A. Adaptability to standard practices for software manufacture.
   B. Full playing time within a given format, as compared with the equivalent stereo recording.
   C. Useable with all major recording media and preferably broadcast.

Now, the four matrix systems described—Sansui, Dyna, E-V, and CBS—are not the *only* ones clamoring for recognition but they *are* representative and each of these companies has made equipment and records available. (The Toshiba system is somewhat similar to the E-V, and the Utah would appear to be identical to the Dyna.) Sansui, E-V, and Dyna encoders are being used by a number of FM stations and no doubt others will experiment with the CBS units when they are available. The big question is: How compatible are these matrix systems? Well, in theory, they aren't. The separation parameters vary and there are those phase differences. But *in practice* the effect of these differences turns out to be much smaller than imagined. For instance, a record made by the Sansui system sounds fine when played through an E-V decoder—so does a Dyna record. Curiously enough, a JVC MPX record also sounds great when played via an E-V decoder—although the recorded level is a little lower, as might be expected. (The carrier has to use up *some* space in the grooves.)

*Four Channels and Compatibility, *A.E.S. Journal*, April, 1971, Vol. 19, No. 4, pp. 267-79.



Scott 444 Quadrant Receiver

Toshiba SC410 Matrix Decoder

JVC 5100 Add Amplifier

Astrocom 307 Cassette Deck

Fisher TX420 Tape Player, 2/4 Chan. Converter

All the matrix systems so far tested are compatible enough to give a spacious surround sound, although the reproduction might not always be accurate as to position. Moreover, all the decoders will produce a four-channel sound from any two-channel source although results vary according to the recording or broadcasting techniques used. Sometimes the extra breadth and the sense of being in the actual concert hall is most exciting, sometimes the impression of instruments playing away behind you —where you *know* they ought not to be— is annoying to say the least. It should be noted that the Dyna system is really a speaker matrix only and does not need another stereo amplifier. However, you cannot play four-channel tapes over such a system—at least for optimum performance.

The following is a list of records which give good results when played through a decoder. The majority of these discs also sounded fine with the simple Hafler 1 system which uses a rear speaker fed with a difference signal from the two channels. A few gave better results with the Metrotec version of the E-V decoder which has provision for encoding the rear channels only, thus giving greater separation in the front. But, of course, this is a matter of taste and a lot depends on the speaker radiation patterns too. Incidentally, this unit also will decode front channels only, as well as all four.

Mantovani in Concert, from the Royal Festival Hall **London PS 578**

1812, Philadelphia Orchestra, Ormandy **RCA LSC 3204**

Johnny Otis Live at Monterey **Epic EG 30473**

Bach Cantatas 130, 67, 101, Orchestra de la Suisse Romande, Ansermet, Choir Pro Arte de Lausanne **London 26098**

Charles Lloyd in the Soviet Union (Tallin Jazz Festival) **Atlantic SD 1571**

Through a Looking Glass, Erik Satie, Camarata Chamber Orchestra, S. Sax London **Deram DES18052**

Bridge Over Troubled Water, Ray Conniff and the Singers **Col. CS 1022**

Tapestry, New York String Ensemble, J. Talbot **Col. CS 9442**

Aristocrats of Swing, King Arthur and his Men **Audiophile ST 59**

O Sacrum Convivium, Modern French Organ Music, Choir of St. Johns, Cambridge; S. Cleobury; organ **Argo ZRG 662**

Haydn Creation, Karajan **DGG 270 7044**

Scarborough Fair, Simon & Garfunkel **Col. CS 9363**

The following were specially recorded using the Dyna or E-V system.

Polka Variations, Dick Rogers & his Orchestra **DynaQuad KLP-6**

Today's Hits, Jack Dorsey & 101 Strings **Quad Spectrum QS-4**

Soul of Spain, Jack Dorsey & 101 Strings **Quad Spectrum QS-1**

Dyna Demonstration Record **Vanguard SPV-7**

Movin' On, Dick Shory, Percussion Pops Orchestra **Ovation OV/14-03**

Permissive Polyphonics, Enoch Light **Project 3 PR 5048SD**

A large number of four-channel discs have appeared under the Project 3 and Ovation labels. Those interested in obtaining catalogs should circle READERS SERVICE CARD No. 135 for Project 3 and No. 134 for Ovation. Information on Quad Spectrum may be obtained from Alshire International, P. O. Box 7107-A, Burbank, Calif. 91505, while Dynaquad KL Records can be contacted at P. O. Box 55-A, Hubertus, Wis. 53033.

Equipment Profiles

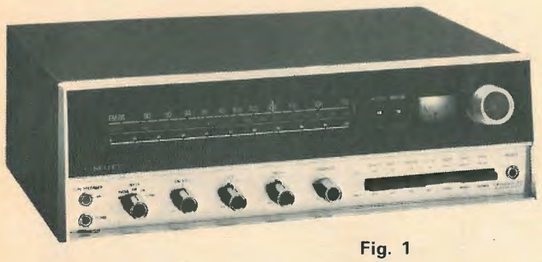


Fig. 1

Scott Model 387 AM/FM Stereo Receiver

MANUFACTURER'S SPECIFICATIONS

FM Tuner Section. IHF Sensitivity: 1.9 μV. **THD Mono:** 0.6%. **THD Stereo:** 0.8%. **S/N:** 65 dB. **Capture Ratio:** 2.5 dB. **Cross-Modulation Rejection:** 80 dB. **Selectivity:** 42 dB. **Stereo Separation:** 40 dB.

AM Tuner Section. IHF Sensitivity: 4 μV @ 600 kHz. **IHF Selectivity:** 32 dB.

Amplifier Section. Continuous power (rms), both channels driven: 85 watts/channel @ 4 ohms, 55 watts/channel @ 8 ohms. **THD:** 0.5% at rated output. **IHF Power Bandwidth:** 10 Hz to 38 kHz. **Phono input sensitivity:** 4.2 mV or 8.5 mV. **IM:** 0.5% at rated power output. **Hum and noise, Phono:** -70 dB (ref. 4.2 mV input):

Dimensions: 17½ in. W × 5¾ in. H × 14¾ in. D. **Retail Price:** $449.95.

Pegged at just $100.00 below H. H. Scott's "top of the line" Model 3900 receiver, this Model 387 is such an *excellent* product that we would, frankly, be interested to see just how much more quality and performance could be built in for another $100.00. As with so many H. H. Scott products, the FM tuner performance leaves little to be desired—it is truly "state of the art." The amplifier section, a real powerhouse at 85 watts per channel (4 ohm loads), meets just about all of its specs.

The Model 387 has the upper portion of the panel "blacked out" by means of a section of tinted plastic until power is applied to the unit, at which time the dial scale becomes brightly illuminated in red, green, and pale green for logging scale, AM scale and FM scale respectively. The logging scale is more decorative than useful, since it is calibrated in units of ten from zero to one hundred. The FM scale, on the other hand, is calibrated accurately at every megahertz. Adjacent to the dial scale are a series of illuminated words denoting the setting of the selector switch, as well as the Perfectune indicator which we shall discuss shortly. Finally, the upper portion of the panel contains a peak-reading tuning meter and a large tuning knob coupled to an effective flywheel. The lower portion of the panel is finished in gold and includes controls for INPUT selection, BALANCE, BASS (dual concentric control for separate adjustment of left and right channel), TREBLE (also a dual control), LOUDNESS (which, in its furthest counterclockwise setting turns off power to the set), and a series of seven push buttons of the push-to-make, push-to-break type. The pushbuttons activate either of two sets of speakers, turn the FM muting circuits on and off, activate the high frequency cut filter, switch from mono to stereo, provide a tape monitor switch, and introduce or defeat the loudness compensation action. A stereo headphone jack at the lower right and a pair of tape recorder input and output jacks (parallelling those on the rear panel) completes the front panel layout.

The rear panel contains several novel features in addition to the usual input and output jacks. While antenna inputs for 300-ohm and 75-ohm transmission lines are not unique, this is the first time we have seen a proper coaxial connector supplied for the 75-ohm alternative. A switch selects either impedance. The loopstick antenna is supplied separately, equipped with a special connector plug and a mounting bracket. This is a welcome packaging innovation, since the normally protruding AM loopstick is often subjected to mishandling in shipment. The power line cord is also separately packed and connects to a matching receptacle at the lower left corner of the rear panel. An a.c. convenience outlet, a line fuse, and two speaker fuses as well as a terminal strip (with removable jumper) for external AM antenna are also located in this area of the panel. Speaker connections are made in two ways. The SPEAKER 1 connections are made to the more usual barrier terminal strip. The right side of the rear panel includes input and output jacks, a two-position preamplifier sensitivity slide switch, a pair of microphone input jacks, a grounding terminal for record changer or turntable grounding, and a special three-position BALANCE slide switch. This switch allows the listener to "A-B" the level of sound between his left and right speaker systems to determine if the program source is balanced with respect to left and right inputs without having to rotate the front balance control from one extreme to the other. The center position of the switch restores normal two-speaker operation to the system. In all, the rear panel is intelligently laid out. The microphone input jacks (as we have stated in other equipment reviews) would be more useful if brought up front since in custom cabinet installations it is a bit of a nuisance to have to get around to the back every time one wants to connect a pair of microphones to the unit.

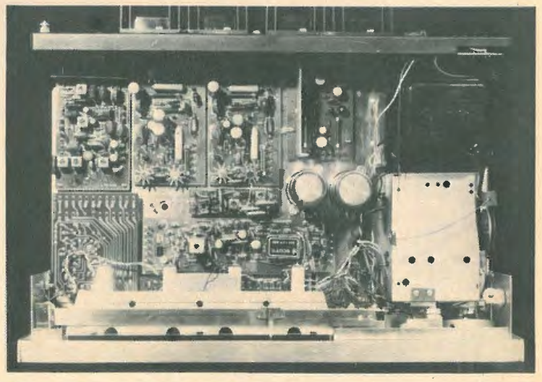


Fig. 2—Top view of chassis.

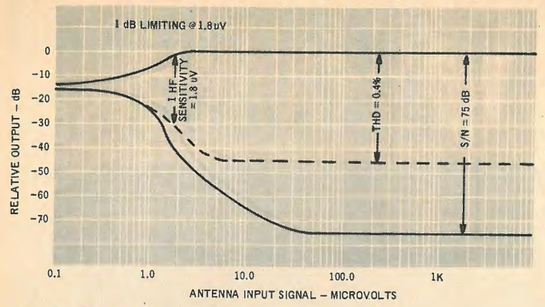


Fig. 3—FM (mono) performance characteristics.

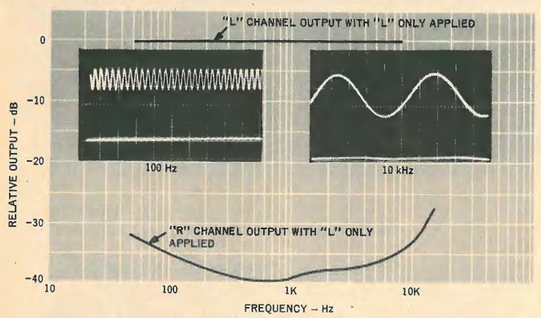


Fig. 4—Stereo FM separation characteristics. Inset photos show separation at 100 Hz (left) and 10 kHz (right).

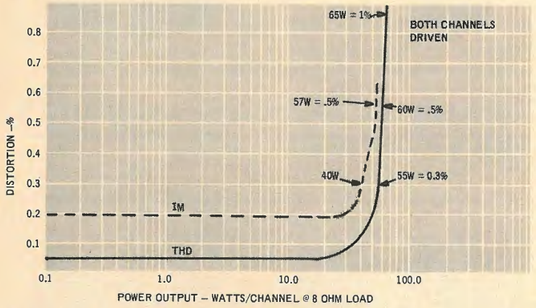


Fig. 5—THD and IM characteristics.

Circuit and Construction

Both circuitry and construction features of the H. H. Scott 387 have so much to commend them that a brief discussion of them is in order. To begin with, we have never seen a more "serviceable" receiver. Seven modular p.c. boards are instantly removable without any tools or soldering iron. The boards are retained in place by nylon "snap-in" pegs and all electrical connections to the boards are made by a series of long pins which mate with eyelet-like receptacles staked to the boards themselves. Thus, if the left-channel driver board should give out some day, simply pop out the defective board and pop in a replacement board. Even after the user warranty has expired (and it includes a generous two years on both parts and labor), H. H. Scott provides a p.c. board replacement service at a nominal $10.00 plus your "used" board. Most of the replaceable p.c. boards may be clearly seen in Fig. 2.

In addition to conventional bi-polar and field effect transistors used liberally in this design, integrated circuits abound as well. The FM IF section has four of them (three in the gain stages and one for the Perfectune circuit to be described later). The multiplex module has one complex IC that does the work formerly done by at least four or five discrete transistors plus a number of diodes. The preamplifier has two IC's, one for each channel. Pretuned permanent filters are used in the i.f. sections for both AM and FM, reducing the problems of alignment to its barest minimum. The power output circuitry is of the complementary symmetry form, employing a matched NPN-PNP output pair supplied with both positive and negative operating voltage (-43 and +43), so that no coupling capacitors are required between output circuit and loudspeakers.

Measurements

Certainly, the H. H. Scott Model 387 has about the best performing and most sensitive tuner section we have ever measured. Major mono performance characteristics are shown in the graphs of Fig. 3. Full limiting and IHF sensitivity were at 1.8 μV (300 ohm input) and, more important, signal to noise had reached an incredible 50 dB at only 2.5 μV and 60 dB at 5 μV of signal input. Translated to more meaningful terms, this means that any incoming signal of 5 microvolts or better would sound as quiet as even the strongest signal received on an *average* tuner, where 60 dB S/N is usually the limit at any signal level. In the case of the Model 387, ultimate S/N reached 75 dB at 50 μV input. THD in mono measured 0.4% while in stereo it was a bit more than 0.8% for full deviation. The muting circuit is effective at signals below 2.5 μV in strength. This means that you will be able to keep the mute switch depressed even when hunting for the distant weak signals. In fact, in our "count" of stations we deliberately scanned the dial with and without the mute circuit in effect and this is the first tuner where we can state that we counted exactly as many received stations in each case, since the mute threshhold is so close to the IHF sensitivity figure. Furthermore, the mute is positive acting—there is no signal strength region in which the mute circuit is in partial effect, so there is no noticeable distortion or attenuation caused by this well engineered circuit.

Stereo FM separation, plotted in Fig. 4 was as good as any we have ever measured, reaching 40 dB at mid-band frequencies and remaining better than 30 dB at every frequency from 50 Hz to over 10 kHz. In addition to denoting an excellent multiplex circuit, this suggests that the i.f. section is extremely phase linear and well aligned. While we normally do not show graphs of right *and* left channel separation (usually, the results are within 1 or 2 dB of each other), it should be noted that in the case of the H. H. Scott 387, balance between left and right channel separation was within 0.5 dB across the whole frequency band. Published specifications with respect to capture ratio and cross-modulation rejection were confirmed, while selectivity was measured at 45 dB, somewhat better than the 42 dB claimed. While this latter parameter is not the highest we have seen, we encountered no case of alternate channel interference in our listening tests.

Perfectune

A very valid tuning indication method, trademarked "Perfectune" by the people at H. H. Scott, has been incorporated in the Model 387. Instead of the usual "zero-center" tuning meter, a special integrated circuit has been incorporated in the FM i.f. module. Fed with d.c. voltages derived from the ratio detector circuit, the IC acts as a "gate" for the Perfectune indicator light, permitting it to become illuminated only when a station has been tuned to precise center of channel, the point of lowest distortion and best audio recovery. Interestingly, in the presence of a very strong signal, the range of dial spread over which the lamp remains illuminated is somewhat broader than it is for a weaker signal. This is, of course, as it should be, since center tuning of a strong station is somewhat less critical than proper tuning of a relatively weaker signal. We noted, too, that in tuning into a stereo station, the stereo indicator lamp

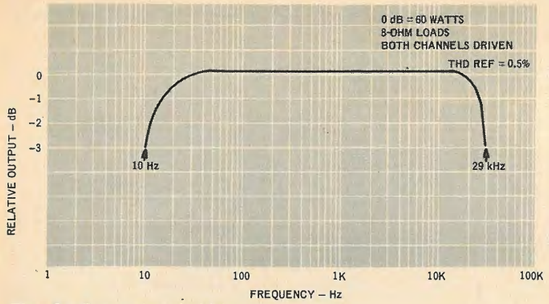


Fig. 6—Power bandwidth.

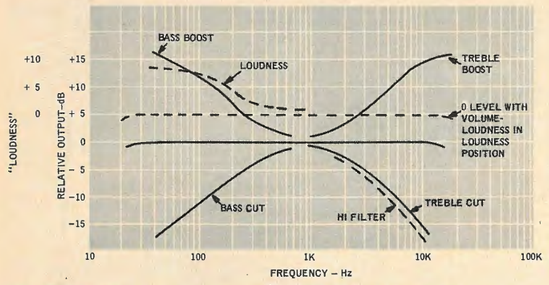


Fig. 7—Tone control, loudness, and filter characteristics.

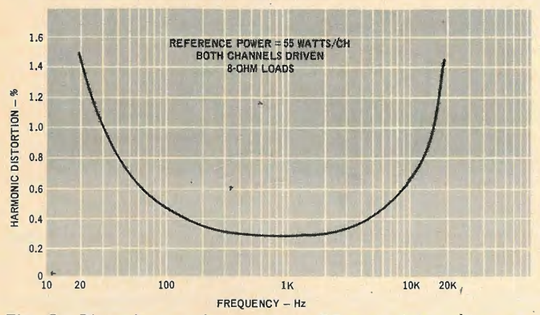


Fig. 8—Distortion vs. frequency at 55 watts/channel power output level.

becomes illuminated as the station frequency is approached and remains on for some distance to either side of the Perfectune indication. In that connection, the stereo indicator is completely positive in its action and never gave a false indication because of interstation noise, regardless of the setting of the mute switch.

Harmonic Distortion and IM for the amplifier section are plotted in Fig. 5. The former reached its rated value of 0.5% at 60 watts per channel with both channels driven (as against 55 watts claimed), while the latter reached 0.5% at 57 watts. One per cent THD was noted at a power output of 65 watts per channel with an 8 ohm load and both channels driven. At 20 kHz, the response (with tone controls set for "flat" response) is down some 3 dB. A slight boosting of the treble control restores uniform response to this upper audio limit. At the low end, audio response is down 1 dB at 17 Hz. Tone control action, shown in Fig. 7, is symmetrical and the range is adequate. A feedback Baxandall circuit is used, providing variable crossover and the ability to introduce moderate amounts of low end and high end boost or cut without affecting mid-range response. We did find the loudness compensation circuit (the response of which is also shown in Fig. 7) to be a bit confusing.

As is pointed out in the instruction manual, depressing the LOUDNESS push button (to provide *uncompensated* flat response) results in the overall *decrease* in volume level of about 5 dB (at mid-band). We would prefer to see the "normal" (or un-pushed) position of the switch as the uncompensating position, since loudness compensation is a "sometime" thing. If there has to be a level shift from one position of the switch to the other, we would have preferred the level to decrease when using the compensating position of the loudness-volume switch since this position is likely to be used at lower listening levels.

The high cut filter, whose characteristics are also plotted in Fig. 8, follows the curve of maximum treble cut almost exactly (having a slope of only 6 dB per octave) and is therefore somewhat redundant, in that it "cuts in" too far to the mid-range frequencies. Thanks to the extreme sensitivity and quieting ability of the 387 we did not find it necessary to use this filter on any stereo FM listening. For owners of "scratchy" old 78 rpm records, the high frequency loss won't mean much anyway.

Listening Tests

The Model 387 is most outstanding in its FM performance. The Perfectune light lit up for us no fewer than 57 times as we scanned the FM dial and in 27 of those instances, the stereo indicator light flashed as well. That's using a multi-element directional antenna in our near-New York City location, but NOT using our rotator. We received some stations clearly and with adequate quieting during which the signal strength meter *barely moved* and when you consider that a 10 microvolt signal causes that meter pointer to deflect one full division that should give you an idea of the kind of signals were were able to listen to and enjoy. Calibration was just about perfect from one end of the dial to the other (and that was a blessing, because some of the stations received were so far out of our area that we had to consult our national list of station frequencies to identify some of them.

Audio power was more than adequate at all levels of single or dual speaker-pair listening in both FM and PHONO settings. Residual hum in all instances was inaudible, confirming our -68 dB reading for phono and the -80 dB reading in high-level input sources. We also experimented with the microphone inputs, using a single dynamic microphone to mix with and comment upon a taped program we had recorded earlier. By placing the MONO-STEREO switch in the MONO position, the 387 serves as an effective two-channel mixer in this configuration. It should be noted that when two sets of speakers are used simultaneously, the circuitry is arranged to insert high wattage 2-ohm resistance in series with the output lines. This is done to prevent the net impedance presented to the amplifier from going below the safe 4-ohm limit. Although this feature does reduce maximum available audio power to the combination of speakers, there was still plenty in our instance, and it is preferable to lose a fraction of the available power than to keep blowing speaker line fuses because of too low an impedance load connected to the output terminals. Our transient response tests indicated excellent damping, though this parameter was not specifically measured, since no published specification was available with which to compare it.

The H. H. Scott Model 387 is a big receiver—big in power and performance, as well as in physical size. The serious audio enthusiast will, upon auditioning it, quickly recognize it as the product of one of the pioneering companies in our industry. While H. H. Scott was there when it all began, they have certainly kept up with technological progress in solid-state design—that is clearly evidenced by the Model 387.

Leonard Feldman

Check No. 56 on Reader Service Card

EPI Model 50 Speaker System

MANUFACTURER'S SPECIFICATIONS

Response: 55-18,000 Hz ± 3 dB. **Recommended Amplifier RMS Wattage Range:** 10-25. **Crossover:** 1,800 Hz, 18 dB/octave. **Size:** 10 in. × 13 in. × 18 in. **Weight:** 15 Lbs. **Price:** $55.00 (packaged in pairs).

The EPI Model 50 loudspeaker is another fine product from Epicure. It is even smaller than the excellent Model 100 but retains many of its good features. The system is packaged in stereo pairs and costs $110.00 per pair.

The walnut-finished enclosure, which measures 13 in. by 10 in. by 8 in. deep contains a 6 in. acoustic suspension woofer, a 1 in. inverted dome tweeter and is densely filled with fiberglass-type insulation. A capacitor is used as the crossover network, working at 1,800 Hz, and a three-position slide switch attenuates the tweeter in two of its positions. Both drivers have heavy magnets and are obviously well constructed. They are mounted from the front of the flakeboard panel, with a removable Masonite panel covered with black grille cloth fitted on top. Spring-loaded push-type speaker input terminals are recessed in the rear, along with the tweeter control.

The tweeter is the same unit as used in the EPI 100, which was reviewed in the May, 1970 issue. As we noted then, EPI uses a miniature acoustic-suspension design for the tweeter in order to produce appreciable power at high frequencies, rather than using a larger and more directional tweeter. The voice coil and tweeter cone are rigidly interlocked and supported with a rubber-impregnated-cloth surround, the purpose of which is to damp out resonances while allowing freedom of motion.

EPI notes in their catalog description of the Model 50 that it was "specifically designed to work in the corners of the room, placed either on the floor or suspended directly below the ceiling, and aimed so that the two speakers in a stereo pair are facing each other along the wall that is between them."

As shown in Fig. 1, our frequency response tests, using ⅓ octave band pink noise, revealed very smooth response, which was confirmed later by our listening tests. The response extends from 45 to 16,000 Hz ± 3 dB, and dispersion was also excellent, as shown in curves 1B and 1C.

The impedance curve in Fig. 2 reveals an average value of 9 ohms, with resonance at 53 Hz. Dispersion was good, showing some beaming above 9,000 Hz.

Harmonic distortion, measured at 95 dB SPL, with four octaves of pink noise in the region of 300 to 5,000 Hz, is plotted in Fig. 3. Distortion is low throughout, rising sharply below 120 Hz, which is to be expected from such a small enclosure.

Efficiency is low, as in most high compliance bookshelf speaker systems. One electrical watt produced 87 dB SPL at 40 in. on axis at 1,000 Hz, with the tweeter set in LOW position. This was the position that sounded best.

Listening Tests

In listening tests, the Model 50's transient response stood out and we found we could feed the unit a lot of power before it would break up. An open sound with clear highs and solid bass is characteristic of this stereo pair. For adequate reserve power, played in average surroundings, we recommend an amplifier having 30 watts rms per channel to properly drive this speaker.

The Model 50 makes a great starter system which can be relegated to the den or bedroom in the future. Another possibility is the rear channels of a quadraphonic system, especially if EPI 100's are used for the front pair. *Alex Rosner*

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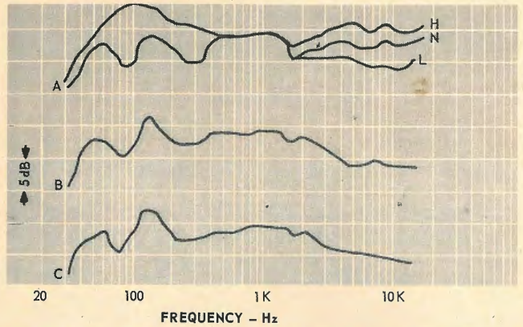


Fig. 1—Frequency response to ⅓ octave pink noise. Fig. 1A shows on-axis response; Fig. 1B is 45 degrees off axis. Fig. 1C is composite of five curves averaged on and off axis or an effective power response.

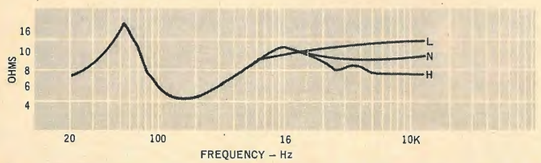


Fig. 2—Speaker impedance curve at the three tweeter attenuator settings.

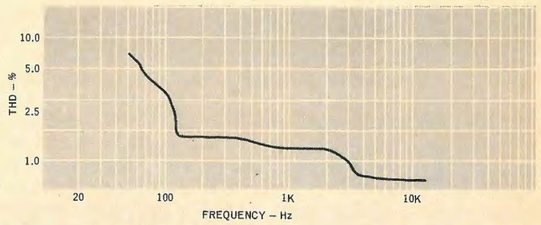


Fig. 3—THD at 95 dB, which corresponds to approximately a 7 watt input to the speaker.

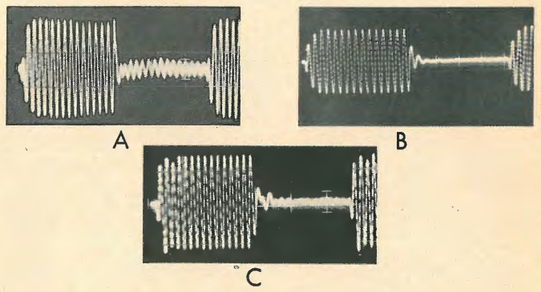
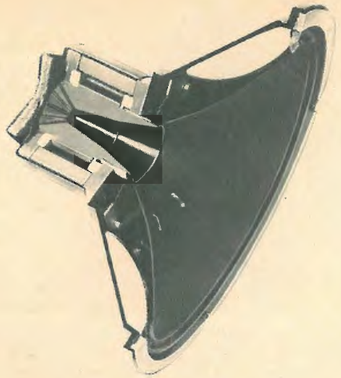
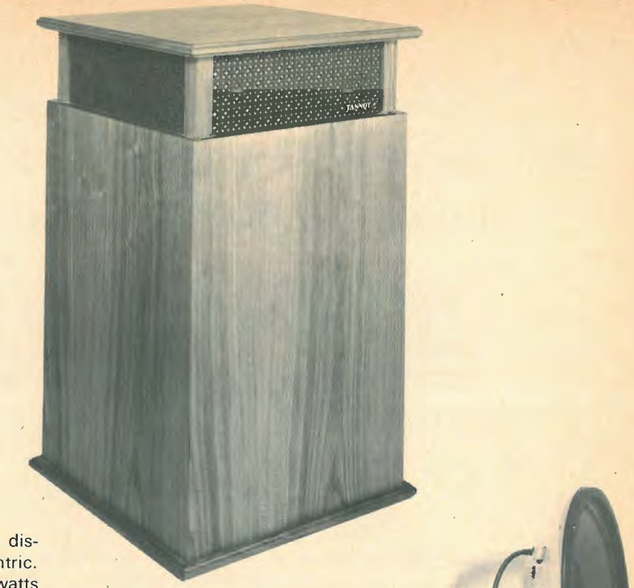
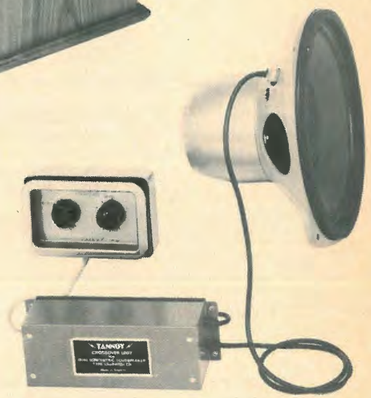


Fig. 4—Tone burst response of the EPI Model 50 at 1,000, 3,000, and 5,000 Hz.







Tannoy Model Orbitus-1 Speaker System

MANUFACTURER'S SPECIFICATIONS
Sound pattern: 360 degrees with vertical and horizontal dispersion. **Speaker:** Special version of 12-in. Dual Concentric. **Response:** 35-20,000 Hz. **Power Handling:** 30 watts integrated program material. **Cabinet Finish:** Oiled walnut, top and sides, with cloth or grille fret. **Size:** 29 in. H × 17 in. × 17 in. **Weight:** 50 lbs. **Price:** $255.00.

The Orbitus 1 is a new system, utilizing Tannoy's tried and proven 12-in. Monitor Gold Dual Concentric loudspeaker. Until now, Tannoy has had various direct radiator and horn type enclosures available for the Models Ten, Twelve, and Fifteen drivers. The Orbitus 1 enclosure is a ducted port reflex baffle with the speaker facing upwards and into an exponentially shaped deflector which redirects the sound waves outwards by 90 degrees into 360 horizontal degrees. The cabinet is beautifully finished in oiled walnut on all sides, with an attractive grille cloth camouflaging the "orbital deflector." A small diameter tube terminates at the cabinet's underside, where the electrical input connections and the tweeter balance and roll-off controls are located.

Except for a modified diaphragm surround to allow the loudspeaker unit to work well horizontally, the speaker is the same as Tannoy's popular Monitor twelve and has a free-air resonance of 28 Hz. This speaker is a 12-in direct radiator woofer mounted concentrically with a horn-loaded high frequency tweeter. The 1000 Hz crossover network uses "dynamic balance" and "roll-off" controls. The former changes the amount of high frequency radiated energy without drastically changing the frequency response. The dynamic balance control essentially displaces the response by a fixed amount at all frequencies above 2500 Hz. There are two click stops above and

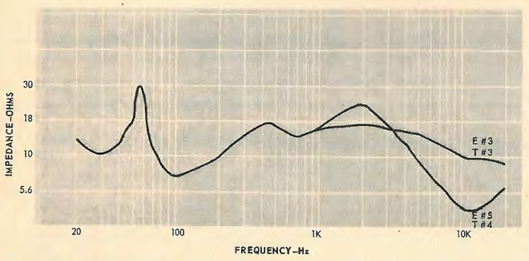


Fig. 1—Impedance curve. Upper curve with energy and treble control in #3 position. Lower curve with energy and treble controls turned full up.

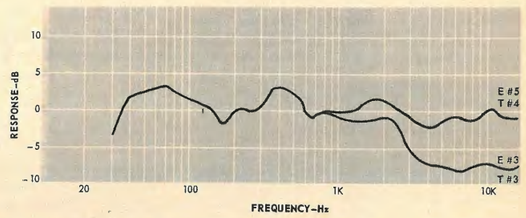


Fig. 2—Frequency response of Orbitus 1 to ⅓ octave band pink noise, measured with calibrated microphone at 1 meter. The upper curve is with speaker's controls set to full on. The lower curve shows the most musically pleasing response of the system, with both controls set to #3.

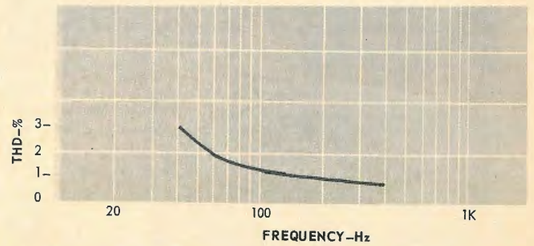


Fig. 3—Plot of total harmonic distortion at 100 dB SPL for the bass frequencies between 40 and 400 Hz.

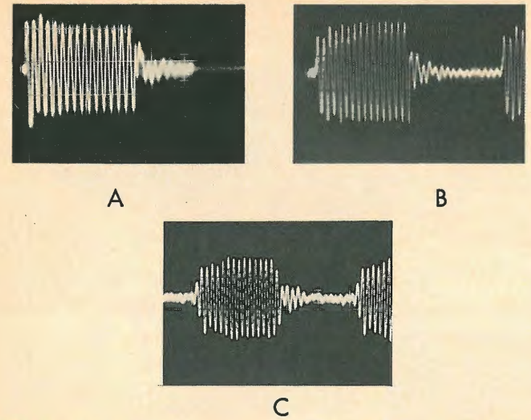


Fig. 4—Tone burst response of the Tannoy Orbitus 1 at 200, 1,000, and 5,000 Hz.

below the normal or level position; each is 2 dB. The second control, for roll-off, attenuates the high end from about the same point. The loudspeaker elements are exceptionally well constructed, using a 7½ lb. Triconal G magnet and 2-in. voice coils for each driver.

The measured impedance curve is plotted in Fig. 1 for two settings of the speaker's HF controls. We found that the resonant frequency varied, depending on floor material. A bare floor shifted the frequency upward, to 57 Hz, while a heavily carpeted floor caused the resonance to go to 50 Hz. With the energy and treble controls set at #3, which is how the speaker sounded best, the impedance averaged out at 15 ohms, dipping to 7.5 ohms at 100 Hz.

Frequency response curves measured 35 to 16,000 Hz ± 3 dB. THD was measured with a 10 volt input signal which corresponds to 6 watts and produced an SPL of 100 dB at 1 meter. The results are shown in Fig. 3. The system can handle large amounts of power. Coupled with its high efficiency, the system can play quite loudly with low distortion.

Radiation characteristics were virtually the same at all angles, since all the energy reaches the ear via reflections. In my listening room, the Orbitus 1 had a warm sound, with a lack of harshness in the midrange and a smooth, diffused high end. For my ears it gave more musically pleasing results with the energy and tweeter controls set to #3 rather than all the way up. These settings naturally depend on room acoustics and program material. In use, the system is not fussy as to placement, although the slight rise in the lower registers could cause a placement problem in some rooms. In others, however, this could be quite desirable. As might be expected, the high frequencies were well distributed and help to give an exceptionally wide stereo image. Response to white noise was quite smooth and well distributed.

As its dimensions imply, the Orbitus 1 requires a medium to large room in which to do its best, and because of its wide radiation pattern, a stereo pair can be positioned further apart than usual. An amplifier of 20 watts rms per channel should be able to drive the Orbitus 1 very nicely. *Alex Rosner*

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Erratum

The JVC 1660-2 cassette-deck was incorrectly listed at $139.95 in the August issue. The correct price is $119.95—an even better value!

DIRECTORY ADDITIONS *September*

RECEIVERS

Panasonic SA-5800

On page 24 please place the B&O name next to the Beomaster 3000 listing, on page 34 place the Rolecor name next to the Rotel RA-610 and Rotel RA-214 listings, and on page 38 place the Panasonic name beside the listings for Models SA-5800, SA-6200, and SA-6500, two of which are shown here.

Panasonic SA-6500

TUNERS

KLH Model 18 tuner

Some specifications for the KLH Model 18 tuner were incorrectly given in last month's directory. The correct figures are given here with apologies to KLH.

MANUFACTURER	MODEL	IHF SENSITIVITY, μV	Capture ratio, dB	Alt. Chan. Selectivity, dB	AM Suppression, dB	Frequency Response, Hz ± 1 dB	Stereo Separation, 1,000 Hz, dB	Stereo Separation 10 kHz, dB	THD, Mono, 100% Mod., %	THD, Stereo, 100% Mod., %	Tuning Indicator	S/N, dB	AM Band?	Dimensions, W x D x H, In.	Weight, Lbs.	Price	SPECIAL FEATURES
KLH	18	2	3.0	35	50	20-15K ±1	35	20	0.5	0.8	Mtr.	55	No	9 x 5 3/4 x 4 1/4	4	129.95	FET front end; 5 i.f.'s; zero-center tuning mtr.; planetary tuning contr.; mx noise fltr.; incls. cab.

MICROPHONES

Following are specifications for Beyer microphones, which are now being distributed by the Revox Corp., 155 Michael Dr., Syosset, N.Y. 11791, and for MB microphones from Stanford International, 569 Laurel St., San Carlos, Calif. 94070. There is a wide variety of other models available in both lines.

Please add this to your August microphone directory.

Beyer M818

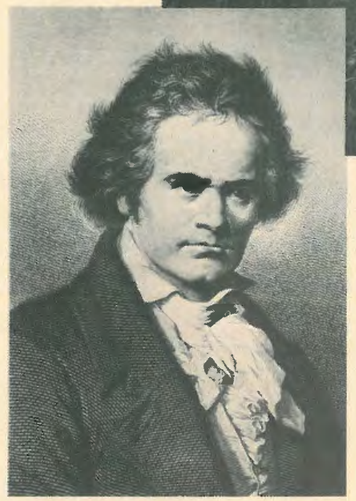
MANUFACTURER	MODEL	Directional Pattern	Operating Principle	Case Material	External Finish	Impedance, Ohms	Frequency Response, Hz to kHz, ± dB	EIA Sensitivity, dBm	Mic Connection	Cable Length, Ft.	Cable Plug Type	Dimensions, in.	Weight, Oz.	Mounting Method	Price	SPECIAL FEATURES
BEYER (REVOX	M818H.L. Kit	Card	Dyn.	Metal	Brushed Chrome	200 to 5,000	50-16K ±3	*	Fixed	to 20	Phone Jack	5 1/4 x 1 1/4	10	Clamp	79.00	Matched mikes w. case, table stands, floor stand clamp, adaptors, stereo mount bar. *0.23 mV/ubar (–73 dBm).
	Soundstar X1HLM	Card	Dyn.	Metal and Plastic	Black and Silver	Switched 200, 500, 25K	30-18K ±2	*	Cannon	16 & up	Open end	7 3/8 x 1 1/4	14	Clamp	75.00	*0.2 mV/ubar (–52 dBm).
	M101N	Omni.	Dyn.	Metal	Matte dark grey	200	40-20K ±2	*	Cannon	16 & up	Open end	4 1/2 x 7/8	3 1/2	Clamp	80.00	*0.18 mV/ubar (–55 dBm).
	M26D	Hyper Card.	Rib.	Metal	Grey and Silver	200	50-18K ±3	*	Cannon	16 & up	Open end	6 x 1 3/4	8	Clamp	90.00	*0.09 mV/ubar (–57 dBm)
	M320	Super Card	Rib.	Metal and Plastic	Black	200	30-18K ±2	*	DIM	16 & up	Open end	3 1/2 x 2 1/2	11	Adaptor	100.00	Built-in bass cut switch. *0.1 mV/ubar (–57 dBm).
MB (STANFORD)	C 520	Card.	Cond	–	–	1K	40-20K	–	T3262	–	–	6 3/16 x 7/8	5 1/2	–	395.00	C 510 similar but omnidir.
	301	Card.	Rib.	–	–	200	40-18K	–	T3261/1	–	–	7 1/16 x 2*	10 1/2	–	125.00	*Basket diameter.
	215	Card.	Dyn.	–	–	200	50-18K	–	T3261/1	–	–	6 x 1 1/2*	4 1/2	–	90.00	*Basket diameter.
	270	Card.	Dyn.	–	–	200	70-15K	–	MAS 30	–	–	5 1/4 x 1 1/2*	7	–	60.00	*Basket diameter.
	207	Card.	Dyn.	–	–	200	80-16K	–	–	–	–	6 1/2 x tapered	4 1/4	–	35.00	

Beethoven '71

Classical Record Reviews

EDWARD TATNALL CANBY

Beethoven: Christ on the Mount of Olives. Deutekom, Gedda, Sotin; Bonn Theatre Chorus, Philharmonic Chorus, Orch. of the Beethovenhalle, Bonn, Wangenheim. **Angel S 36696, stereo, $5.98.**
Beethoven: Mass in C (Messe C-Dur). Kuhse, Burmeister, Schreier, Adam; Rundfunkchor Leipzig, Gewandhausorchester, Kegel. **Telefunken SAT 22512,** stereo, $5.95.



Beethoven is 201; the spillover from the 200th year continues to bring in material of interest. The big Beethoven choral works are the Ninth Symphony and the Missa Solemnis; this pair of earlier pieces make less spectacular listening but both have plenty of impact as out-of-the-routine items, the familiar sound of Beethoven in, for most of us, unfamiliar music. Especially in such excellent presentations as these, one from East and one from West Germany. The Germans have certainly not lost their cultural unity, whatever the current politics.

In all these many years of listening, I had never before actually heard the "Mount of Olives" oratorio, Beethoven's only try at this form, though I had often heard about it as being, maybe, one of his lesser works. Well, it is that, if you wish, but with some marvelously positive qualifications. He wrote it, on commission, in a mere two weeks. The Ninth Symphony took years, an intermittent slice of a lifetime. And so the music, inevitably, is scrappy. Uneven. Some of it, however, is fantastically good, notably the entire first section, a brooding sequence in which Christ tries to reconcile himself to the inevitable. Other segments reveal almost amusingly the "old pro" Beethoven churning out well written, stylish pap, very much in the manner of the day, full of expertly contrived noise and flourish. In Bach, the "crowd scenes," the action moments, are always powerful; in this Beethoven, they are lamentably empty, if incongruously full of good humor. The chorus takes the brunt, a pair of men's choirs (disciples versus soldiers) and a mixed chorus—much vigorous shouting in musical terms, plenty of, so to speak, stage business, precious little musical content.

But that is mainly on side 2. The superb singing of Nicolai Gedda as Christ and Cristina Deutekom as a Seraph ("angel of a higher order...") is a Beethoven thrill-maker not to be missed. The Bonn orchestra under Wangenheim, a young German conductor, is no less than quietly superb, the orchestral music beautifully phrased and shaped, some of the finest Beethoven playing I have yet heard. Don't think the "big" orchestras have any monopoly on such expression! Many listeners, by the way, will find "Mount of Olives" strikingly reminiscent of much in the bigger and better known Beethoven opera, "Fidelio," which came next in line. The musical idiom is remarkably similar; obviously many ideas in "Fidelio" developed out of this work. The opera is a bigger piece in every way; no matter. Take each for what it offers.

The C Major Mass was written on commission for the same Esterhazy establishment for whom Haydn had composed his famous late Masses. It is a curious work, especially for those who know the Haydn. (Almost every choral singer today has sung at least one of them.) The Beethoven attempt to write in the Haydn tradition is obvious everywhere, and successful too, at least from our distant viewpoint. The kinship is immediately evident. On the other hand, Beethoven could not help being himself, and thereby "expanding" the accepted style with more of a roughshod drama, louder, more direct emotions, bigger sounds, noisier climaxes and a great deal of "crudity," such as shouted octave passages, of a sort that would have disturbed the gentler Haydn. It is just these passages that we find typically Beethoven today, but it must be admitted that they are somehow out of place—or perhaps it is the other way round; the Haydn-style Mass is itself out of place in Beethoven. Understandably, the Count Nicholas Esterhazy was not enthusiastic.

An excellent and well informed performance of the Mass here, out of

(Continued from page 63)

Liepzig. It isn't overpowering, but the work itself, compromise that it is (in the period of the 7th Symphony), is—for Beethoven—of a gentle sort, and not to be overplayed.

Performances: A-, B+ Sound: A-, B+

Beethoven: Sonatas No. 26, Op. 81a ("Les Adieux"), No. 15, Op. 28 ("Pastoral"). Ivan Moravec, piano. **Connoisseur Society CS 2021,** stereo, $5.98.

The Beethoven piano sonatas are astonishingly adaptable, considering the exactitude with which they are scored on paper, down to the last *ff* and *pp*. (Earlier music leaves much more to the performer's own judgment.) There are heroic Beethoven players, introspective players, classic perfectionists, and Romantic lionizers, powerhouse performers, gentle people—all can find ways of setting forth the music which can be persuasive. There *is* no one way.

The best thing about Ivan Moravec's Beethoven is that it is powerful but never self-conscious—there is not that ever-so-obvious message, *I am playing BEETHOVEN,* which fascinates plenty of audiences but annoys a lot of us, the way some actors annoy when they play *SHAKESPEARE* and let you know it. Moravec talks directly and without pretence. He also is fleet of finger and his ear is excellent, both for the Beethoven structure and harmony and for the varying drama of the action, whether played up or, more subtly, played down. I found both Sonatas absorbingly interesting, but especially the relatively gentle "Pastoral" (which I once tried desperately to learn myself, and couldn't).

An odd sonic presentation. Side 1 ("Les Adieux") is taken down in Connoisseur's New York church, a place which, my ear says, is quite deadly for piano acoustics. A disturbingly blurred reverb, messing up the harmonies and fogging the impact, plus a kind of pulse, a beat or oscillation in the "echo" (a semi-standing wave?) that is really distressing; and the piano is thin and off-mike sounding. Not good. Side 2, a last-minute substitution, is a live performance of the "Pastoral" made on a concert tour; the pianist thought it was musically better. But you will find the acoustics, even with muted audience coughs (and end applause), far more convincingly normal in sound. Just as well they killed the originally intended version, also made in the New York church.

Performances: A- Sound: C+, B.

(Continued on page 66)

(Continued from page 64)

Frans Brüggen. Blockflotenwerke des Barock (Baroque Recorder Works) Vivaldi, Corelli, Holborne, Van Eyck. with Concentus Musicus, Brüggen-Consort, Anner Bylsma, cello, N. Harnoncourt, gamba, G. Leonhardt, harps. **Telefunken SAW 9560,** stereo, ($5.95).

Here's the Paganini of the recorder on his own, with distinguished colleagues including the conductor of the Consentus Musicus on gamba and the well known conductor, harpsichordist and organist Gustav Leonhardt at the keyboard. It is an extraordinary record and an eye-opener for anybody who might think a recorder no more than an obsolete finger-hole flute without "modern improvements." The man's playing is unbelievable—especially if you've tried a recorder yourself. But then, so is the music, since all these flying scales and arpeggios and arabesques were written down centuries back for other performers on the same crude instrument.

For too long we complacently assigned "obsolete" old instruments to museums on the theory that they weren't good enough to match modern technology and technique. Now that they are back in use, young people like Franz Brüggen have relearned the old ways; the virtuoso in mankind, it seems, is always around and merely awaits his predestined vehicle! The supposed faults and weaknesses of the older instruments—they exist, of course—are merely stimuli to the latent geniuses who are always ready to do the impossible. Now, as then.

Outstanding here are the incredible Vivaldi Concerto and an alternative set of Variations by Corelli for recorder on the old familiar "La Follia" tune, better known in the violin variations played by every fiddler. Excellent recording of the recorder—not an easy thing to do.

Performance: A Sound: B+

Bach: Goldberg Variations. Anthony Newman, harpsichord. **Columbia M30538,** stereo, $5.98.

Here is Columbia's dynamic Bach whiz-kid, the harpsichord-organ man who sometimes plays both in the same piece. (Well, why not, on records?) He's a half-generation down from Glenn Gould and altogether different. Where Gould is thoughtfully introspective,

often off in his own world, Newman is a showman powerhouse, an absolutely brilliant technician who continues to give us the impression he can't help making a super-brilliant noise first, and maybe do his thinking afterwards. Itchy fingers. Not that he doesn't think. He has the musical brain and the performance wherewithal—and how! But the impulse towards massive, high-power projection lurks everywhere and keeps tipping the balance whenever there's an excuse. Off we go into another whirlwind.

Thus, this monumental (and monumentally difficult) set of Variations, originally composed to calm the nerves of an insomniac Count (no—*he* wasn't Goldberg; that was the pianist who did the playing) is set forth here in a fashion that certainly would have kept the Count very wide awake. Maybe a few cat naps here and there, but not many.

Let's put it this way. Nobody listens to the Goldberg Variations today in order to go to sleep. (If you do, it is involuntary and in a concert can be embarrassing.) So the Newman powerhouse approach is useful and interesting. Does a lot to keep a very long work together and building, through two whole LP sides. But sometimes the harpsichord seems to shake in agony, and things are generally hurried; the superb "thought" variations do not really get their due. Make no mistake even so. Newman is an alive musician.

Performances: B+ Sound: B+

Eden and Tamir/Two Pianos Encore! London CS 6694, stereo, $5.98.

Well, you have to find some title—so "Encore!" They've done six LPs before, though I haven't heard any of them, alas.

This is a first-rate man-woman team, coordinated in the playing to a rare perfection, a lot more gracious and fluent in expression than many a two-piano duo. Too many of them play a hard, brittle sort of pianism that leaves some of us very cold. Not these people.

Their first side is the most nearly "popular," with composers like Rachmaninoff, Khatchaturian, Weinberger (that ancient old Polka, at last played at a decently peppy speed), and a music-hall tidbit by Poulenc that could be right out of some night club. All fluently put forth, and serious when there's need for it. Side 2 is music on a higher plane and more interesting too. A lovely Schubert Rondo, done rather breezily but *con amore.* A batch of Brahms piano waltzes and one by Arensky; then three superbly melodic little pieces in canon form by Schumann, originally for a pedal piano and nicely

set for two pianos by, of all people, Debussy.

I didn't like their Brahms much. These players seem to have a somewhat Latin-Russian slant and do not really do the Germanic music very well. But, oddly, the Schumann is perfect. Perhaps (a) because of Debussy's intervention; but also (b) because the French have always had a peculiar love for Schumann, and do to this very day. Something in his music gets through to the Latin temperament, whereas Brahms (and Beethoven) are rarely done without, so to speak, too much of a French accent.

(But I'd like to hear this team's Brahms Sonata in F Minor, Op. 34, before any final judgments. It's on London CS 6583. With Saint-Saëns.)

Performances: B+ Sound: B+

Messager: Suites from the Ballets "Les Deux Pigeons" and "Isoline"; Hahn: Le Bal de Béatrice d'Este. Orch. de Paris, Jacquillat. **Angel S36769,** stereo, $5.98.

So many good composers are still around to be revived. Here's one, his name mostly unknown outside of France, and another who is known mainly for his songs. What aspiring singer hasn't tried Reynaldo Hahn? But it is Messager who wins hands down on this light-hearted ballet disc.

Messager lasted until 1929 but his important work dates itself (in the hearing) as of the gay nineties, more or less, a kind of gracious French equivalent of Johann Strauss Jr., a bit later and more colorful in the harmonies but with the same kind of effortless elegance that endears Strauss to so many of us. Frankly, I was amazed, never having heard more than his name before; this man is the essence of musicality, a born entertainer with that rare ability—to delight with ease and yet to write with real expression. Astonishing that he is not better known. Here's your chance to try him. The music will transport you in moments to the nearest ballet theatre if you've been a ballet habitue at all—you can almost see the whirling figures on the stage. Lovely.

As for Reynaldo Hahn, he of the songs that every singer sings, his ballet music, for my ear, is much more studied, more dated and not half as interesting. One of those semi-Medieval things, once so popular (now we listen to *real* Medieval music . . .) with sort of "antique" dances, in this case not done with much subtlety. Hahn didn't depart until 1947 but this work, too, is of an earlier period. Superior playing by the now-seasoned Orchestre de Paris.

Performances: A- Sound B+

Canby's Capsules...

Keyboard and Fingerboard

Title	Content and Sound
Henri Herz, Franz Hüten (Geniuses of the Parisian Salon). Frank Cooper, pf. **Genesis GS 1006,** stereo, $5.98.	So you thought "salon music" was early Muzak? Not Quite. Herz, Hüten and a host of others (incl. Chopin) wrote the glittery stuff for show-off at lush private 19th C. evenings. Herz is pretty shallow, if gracious; Hüten is solider, faintly Strauss-waltz-like (both were Germanic but French trained). Hüten's variations on opera tunes are nice. Frank Cooper is very serious about his Romantic Revival, but plays well and doesn't exaggerate. His Bösendorfer piano is close, in quietly live background. Moszkowski is much later (d. 1925) but not *that* different. His Etudes fab-difficult but gentler than, say, Liszt. Vered's piano zips them out with ease in a blurry (church) acoustic with a persistent background ambience.
Moszkowski: 15 Virtuoso Etudes, OP. 72, etc. Ilana Vered, pf. **Connoisseur Soc. CS 2023,** stereo, $5.98.	
Fritz Kreisler (Beloved Melodies of). Wanda Wilkomirska, vl., Antonio Barbosa, pf. **Connoisseur Soc. 2022,** stereo, $5.98.	Odd! Two young artists "recreate" a batch of the old Kreisler fiddle ditties everybody used to buy on acoustic 78s. (Some were passed off as by other composers.) Fine—if *you* didn't buy them. Styling is okay, but the oldies were recorded dead—and these are hugely live in big, blurry church sound. Kills it for me. After all, recording technique is part of the nostalgia to be brought back, even if no need to be literally lo-fi.
Romantic Guitar. Julian Bream. (Paganini, Mendelssohn, Schubert, Tarrega.) **RCA LSC 3156,** stereo, $5.98.	Bream, the British genius of lute/guitar, plays any style, any way—but here he is beautifully idiomatic, pure guitar (with a nicely Segovia sound). Mostly his own transcriptions of piano, string quartet, violin-and-guitar, and good ones. His rhythmic fluency and accuracy remain unbeatable anywhere.
Schubert: Phantaisie, Op. 159. Tchaikovsky: Sér. Mélancholique, Op. 26; Valse (Ser. Op. 48). Heifetz. Brooks Smith, pf., Chamber Orch. **RCA LSC 3109,** stereo, $5.98.	More serious fare—not too well projected. The late Phantaisie is tremendous, but RCA puts Heifetz's fiddle up close, emphasizing scratchiness and—alas—H.'s failing technique with vital piano (excellent playing) in background. The Tchaikovsky Serenade movement is worth having, but the solo arr. of familiar Valse isn't.
Alicia de Larrocha. Grieg: Sonata Op. 7; Nocturne. Mendelssohn: Capriccio, Op. 33, No. 1; Vars. Sérieuses, Op. 54. London CS 6676, stereo, $5.98.	Ha! Here, the indomitable Larrocha really blossoms out (where her Ravel was a misfit). Still, as always, a bit more pedal than now customary, and a big, live sound—but it all fits the opulent early Grieg and the two vigorous Mendelssohns. She is pianistically passionate. Good for both composers.
Prokofiev: Visions fugitives, Op. 22; Sarcasms, Op. 17; Sonata No. 5, OP. 38/135. Yekaterina Novitskaya, pf. **Melodiya Angel SR 40164,** stereo, $5.98.	Tremendous! Donno what the Russians do to their young pianists. This one's Prokofiev (she's around 18) is both dazzling and instantly communicative—she lives and breathes the music, and so will you. Early-modern P., WWI period, bitter/sweet dissonance à la "Sacre." The Sonata, 1922, was recomposed in the fifties, his last years. A splendid disc.
Bach: Six Sonatas, Violin & Harps.; Two Sonatas, Violin & Continuo. Sonya Monosoff, vl.; James Weaver, Hps.; Judith Davidoff, gamba. **Cambridge CRS 2822** (two discs), stereo, $11.96.	The two Big Men of Baroque in violin sonatas, with continuo (figured bass, not written out in detail) and, in the six Bachs, with elaborate written-out keyboard part. Both versions add gamba to the bass line. The U.S. recording beats the German, with Monosoff's wonderfully smooth, accurate violin, a good clear liveness and perfect balance. Lautenbacher's Handel is good but less precisely accurate, her acoustics less helpful, the balance too much toward the fiddle. Not bad—Monosoff is simply better (and costlier!). I'd say don't miss her, cost or no, if you like Old Man Bach.
Handel: Sonatas for Violin & Continuo, Op. 1, Nos. 3, 10, 12, 13, 14. Suzanne Lautenbacher, vl.: Hugo Ruf, Hps.; Joh. Koch, gamba. **Nonesuch H 71238,** stereo, $2.98.	
Bach: Two Concertos for Two Harpsichords & Orch., Two Concertos for Harps. & Orch. Geo. Malcolm, Simon Preston, Hps.; Menuhin Festival Orch., Menuhin. **Angel S 36762,** stereo, $5.98.	This is the kind of Baroque the kids'll play through six times at top volume. Brilliantly projected, full of bounce, quite speedy in all movements. S. 1061 and 1060 (C and C mi.) for two, S. 1056 and 1058 (F mi., G mi.) for single harpsichord (Malcolm).

Pablo Casals. Columbia M5 30069 (5 discs), mono and stereo, $29.98.

I'm not even playing this monumental five-record assemblage, but I can give you a good idea of what's in it for you. It is, of course, a legitimate repackaging job, older material supplemented by newly recorded additions and the usual enormous booklet (24 pages), the whole in a pretentious fat white box. Whether you indulge in purchase or no depends on whether you dig.

"Casals" is in two parts. First, "Casals the Musician" divides into (a) a batch of "legendary" recordings from the early electrical 78 era, all borrowed with kind permission from Angel, out of the E.M.I. catalogue, and (b) a group of Columbia Casals festival recordings, 1952 at Prades, 1953 the same, and 1969 at Marlboro. These range through assorted standard chamber music and orchestra repertory, with Casals as cellist, on to the later items—the last side in stereo—where Casals conducts. "Casals the Man" offers two sides of Casals' voluminous recorded commentary—he loves to talk about his art and does so persuasively, if in the most amazingly old-fashioned terms. (Why not—he's almost 100!)

Indeed, the Casals mystique dates itself as about 1905 on the average, in both the playing and conducting styles and in his general attitude and philosophy of music. If you worship at the Casals shrine, all this is very much part of the glory. Even if you don't, you may enjoy the period-piece nostalgia of it all. But if you want "normal" modern-sounding performance, go somewhere else. The earlier festival recordings, too, are not good on records—too nervous and intense (before a celebrity audience), full of minor slips and bad ensemble, inferior in acoustics and instrumental balance. One should *not* record famous musical occasions live, unless purely as documentary. One seldom does these days.

Performances: A? C? Sound: C- to B

Bernstein conducts Mozart. (Symphonies No. 41, "Jupiter"; No. 36, "Linz"). New Philharmonic, Bernstein. **Columbia M 30444,** stereo, $5.98.

Bernstein in his late years has become a great, if personalized, interpreter of Romantic music with lively ideas and enthusiasm and sincerity that get through in the listening. The frequent eccentricities of detail are very much of the Romantic period and suit the musical expression. But here we have Mozart. I found these two performances just plain annoying. Full of the Bernstein personality, a sort of clumsy overdoing of the Romantic bit! Even to the vast sound, as of a huge orchestra in an enormous hall (which probably was the fact of the matter). Fast and furious, overly slow, full of tricky rhythmic touches, in a couple of words, a self-conscious Mozart, and the self is Leonard Bernstein.

I'll admit that the youngest generation of performers, notably pianists like Peter Serkin, treat Mozart in a similar Romantic fashion, like so much passionate Schumann; it is a new style. But Bernstein, being definitely older, somehow just makes it sound like Bernstein intruding into what might speak very well for itself with a less ostentatious "interpreting" all along the way. It is his worst attribute when the music is of this sort.

Performance: B- Sound: B-

Beethoven Bittersweet. Benninghoff. **SSS 15,** stereo, $0.98. With 7-inch bonus record.

Benninghoff's Church Bach. SSS 17, stereo, $4.98.

You know—it's easy enough for a record critic to decide what he thinks about a thing like this—the reaction comes immediately. What bothers him is *why*. How to explain it, to himself and to his readers.

I found these two rock-classic things just abominable. Since I very much respect rock in general and I am *not* averse to using the classics in any form that works out into something good, like, say, Bach on the Moog, my judgment here isn't merely because one shouldn't tamper with the great composers! I say, tamper with them whenever you want—but at your own risk. They're good. *You* have to be, too. These guys (the youthful Benninghoff and associated performers) are fatuous. Period.

Even as rock, I'm rather sure, they won't go over very heavily. It is the most desultory, unimaginitive rock, the sort that is played in tired discotheques for desultory dancing, or on tape recorders for cocktain party background music. Not *musical*. Amateurish in the tunes, conventional in the instrumental effects. And then—Bach and Beethoven. Pretentious titles, that sound fancy. A brief, garbled excerpt from a familiar piece, usually with a few notes disastrously wrong, just enough to kill the idea dead. Then—rock, for awhile, and maybe another excerpt at the end, for no particular reason except to fulfill the title.

Much of the Beethoven-Bach is played by a seeming woodwind group of flutes and clarinets (is it done by overdubbing or mixing?) which does give an occasional curious and interesting effect to the straight Bach or Beethoven bits. But why? This stuff is worthy neither of rock or Bach.

Performances: ? Sound: B+

Bach/Glenn Gould. (Well-Tempered Clavier, Book 2, Nos. 17-24). Columbia M30537, stereo, $5.98.

With this record Glenn Gould completes his intermittently released recording of all the 48 Preludes and Fugues in the two books of the "Well-Tempered." No doubt they'll all be out in a massive single volume of discs before long.

Is it fluent memory on my part that gives these performances a quite different and more mature feel than the first, and much more eccentric, Gould Bach releases? He has always been an original, a thinking piano mind, and he has without any doubt grown, from a gangling pianistic kid to a solidly-connecting adult keyboard communicator. How much of this comes through—and unbalances—the successive volumes of this series I am not able to say at the moment, not having my Complete Gouldiana at my stylus tip. But for those who own the earlier Gould "Well-Tempered" records the comparison should be endlessly interesting. The tempi in these latest recordings are steady, rock-solid and uneccentric but the music, for all of that, is never stodgy; the phrasing, shaping of ideas, the longs and the shorts, staccato and legato, are beautifully and musically calculated to keep everything rolling along and expressive. Excellent. As always, Gould is a pure pianist, playing Bach in terms of that modern instrument. But his somewhat percussive touch, non-use of the sustaining pedal and the phrasing itself (emphasis not through loud and soft—piano and forte—but through staccato and legato) all tend to parallel the basic impact of the music on the harpsichord. This is the ideal approach and far better than the once-popular method of "banging out" the loud tones, as the piano can only too easily do and the harpsichord can't.

Yes—Glenn Gould still sings along, out of tune. They can't quite suppress him though they try.

Performances: A- Sound: B

Berlioz: Romeo and Juliet (The Orchestral Music). Carlo Maria Giulini cond. The Chicago Symphony Orch., Ampex/Angel M36138, open reel, 7½ ips, $7.95.

As you are probably aware, both Angel and London Records are now recording the Chicago Symphony Orchestra. This, along with Deutsche Grammaphon recording of the Boston Symphony, signals a strange thing which has come to pass with some major American orchestras, to wit: Foreign record companies can record these orchestras, when our own companies find this too expensive. With union rates these days, even a standard work like the Brahms Third Symphony can cost from 25 to 30 thousand dollars! The reason is that in Europe the classical segment of the record market is still a healthy 26-27 percent. I was told by an executive of one of these companies that the "big time" American orchestras are considered very "glamourous" and are highly admired in Europe. The general opinion is that our orchestras are more technically polished than many of the much-touted European orchestras, which is a surprising admission indeed! So the combination of a "name" European conductor with a top American orchestra on a record evidently rings a lot of cash registers on the Continent. The differing approach to the recording of these orchestras, as compared to the techniques used by the American record companies, is a matter of considerable interest.

In the case of this recording of the Chicago Symphony, it is unfortunate that Angel Records came upon the scene after the reconstruction of Orchestra Hall ruined the once magnificent acoustics that were a recording engineers' dream. They have had to use the Medinah Temple, which can be a tricky hall. When RCA recorded the orchestra there, results were variable. When all elements jelled properly, they produced some fine recordings, and to prove that a really sensational recording can be made there, listen sometime to the RCA disc of the "Martinon 4th Symphony." Angel has taken what might be called the "European" approach in this recording. They have opted for the very broad acoustic perspective, with sort of "row 20" miking that gives a very panoramic sound. Directional effects are less pronounced than the American counterpart. There is more "blending" of the orchestral choirs. Some will like this technique, but for others, including yours truly, more orchestral definition would be preferred. The acoustics of the hall are spacious enough to permit a tighter, more close-in pickup, to give that desirable blend of sharp crisp detail with plenty of "liveness" and "presence." This recording in my opinion has a shade too much of the hall reverb. It is very clean, but the brass just doesn't have enough "bite," the tympani are a bit muddy, the sharp transients of the cymbal are blunted. I think there is a tendancy with certain engineers and A-and-R men to forget they are making a recording which will be listened to in the home and this imposes certain problems. For example, many A-and-R men defer completely to the wishes of the conductor and it is all too common that for a recording session the orchestra is set up in typical concert array, rather than in a configuration which is specifically to aid in recording. The sheer disparity in the size of the concert hall and the listening room, along with the fairly high damping of the typical living room, are factors which weigh against trying to make a recording with the so-called "concert hall bloom," which when played in the home is sonically amorphous. The idea is to make the recording in such a manner that when it is played in the home it gives us the psychoacoustical equivalence of the concert hall experience. Anything we can do to aid this is valid. . .hence our preoccupation with four-channel sound and the ultimate desirability of many more channels, impractical as that may seem at present. Of course, four-channel stereo can and has been misused in classical recording. Multi-channel sound is the way to go in our quest for realism, but there are rules and conditions which we must obey if we are to derive maximum benefit from these techniques. Please don't misunderstand me about this recording. I think it is a good early effort, it makes for pleasant listening and Giulini gives us a fine performance and gets great playing from the orchestra. But I know what quality is possible with this hall, and while this recording may appeal to the European market (which is probably the main objective), I think it is a bit off the mark for American tastes. As a footnote to this, there was a prominent European record company which used the "MS" stereo technique for years, and it's recordings never had very substantial sales here. Then a few years ago they switched to the American "spaced array" technique on a minimum of three channels and they have enjoyed a much rosier sales picture in this country. In any event, it is to be hoped that Angel gets a good enough response from their Chicago efforts to warrant continuation of this most interesting recording project.

Weingarten Looks At FRANK SINATRA

HE IS SHOW BIZ' most famous retiree of '71. And he's the guy who learned every cobblestone in Tin Pan Alley and proved that he knew equally well how to treat the chartbusters of three decades.

A deluge of re-releases can be expected now that Francis Albert Sinatra has retired his vocal chords, but there's obviously some unreleased material still in the Reprise library. Proof is evident on **SINATRA & COMPANY** (1033), a disc that contains 14 new cuts—and the assistance of Antonio Carlos Jobim (tunesmith for the entire first side's seven entries), Don Costa (who arranged the flip side songs), and Eumir Deodato (who arranged the Jobim pieces).

Sinatra's phrasing remains only an eyelash from perfection; his voice retains that smooth, mellow, casual restraint gained in the past decade; his range, unfortunately, continues to dwindle, but the arrangements here show there's really no need to use big brass sections to cover up the flaw (as had been attempted in recent outings).

Noteworthy on side one are "Drinking Water (*Aqua de Beber)*," an exciting, upbeat tune whose bossa nova rhythms turned it into a chart contender; "Wave," a zinger of a cut, on which he hits one of the lowest notes ever, and "One Note Samba *(Samba de Uma Nota So)*," which from time to time shows the vocal depth he's lost.

The second side is highlighted by a pair of John Denver compositions, "My Sweet Lady," a lush and lovely item, and "Leaving on a Jet Plane," proof he can cope with mod-ern music and isn't retiring because of necessity, the bouncy yet restricted "Close to You," the Hal David-Burt Bacharach evergreen that here is pleasantness personified, and "Bein' Green," a singular Sinatra success that metamorphoses the "Sesame Street" tune by Joe Raposo into a stringed sentimental ballad-like affair.

His personal life notwithstanding to the contrary, as the lawyers in divorce cases say, his flamboyance and arrogance also pushed to the back of the mind, The Voice is still Champ—leaving the record business on top, for this one can compete successfully with any platter on the market.

PEARL'S PEARLS (RCA Victor, LSP-4529) finds the 53-year-old Pearl Bailey singing straight (without the multitudinous asides that made her what she is) on 10 cuts. Pearlie Mae's still uniquely recognizable, however. Superb backing is by Louis Bellson and his orchestra. Best tunes are "Here's That Rainy Day," "Close to You," "If You Go Away," and "It's Impossible."

TOM JONES SINGS 'SHE'S A LADY' (Parrot-London, XPAS 71046) shows the singer has matured greatly since "Green Green Grass of Home" days when he sounded like a white country singer trying to be Black. There's good variety here, with "She's a Lady," "Puppet Man," and "Ebb Tide," all hits in varying degrees, highlighting the outing. Also good among the 11 tracks are Jimmy Webb's "Do What You Gotta Do" and Roy Orbison's "In Dreams."

NO, NO, NANETTE (Ranwood, R8087) features songs from the nostalgia-filled Broadway smash as played by Lawrence Welk's orchestra. Welk's bubble-machine may have had the soap removed by the networks, but he rolls on via syndication and recordings. The Welk Singers (a dozen of 'em, equally split between male and female) do what is expected. Best are "Tea for Two" and "I Want to be Happy."

LIVE CATFISH (Epic, E30361) is a five-man group that is lousy (gee, teacher, I know you said never to use that word, but it's the one that fits best). In fact, they're lousy by any standards you or teacher want to apply. There are six cuts, sort of rock 'n' roll and blues, recorded live at the Easttown Theater in Detroit. Bob Hodge is featured on vocals (if that's what they can be called). If they improve, they could climb all the way to mediocrity.

PEPPER'S POWPOW (Embryo, SD 731) is an attempt to capitalize on the publicity the Redman has been getting lately. Jim Pepper, whose lineage is Kaw and Creek Indian, utilizes very ethnic material (including war dances). He sings and plays tenor sax, but somehow it all seems oddly foreign to pop music-oriented ears.

LOUIE ROBERTS (Decca, DL 75279) is a boy whose singing leaves no doubt that he's just that; there's no depth to his voice whatsoever. All 12 cuts here are countrified, but come out bland anyway. Roberts does have a good yodeling quality, if you like that sort of thing. The package contains a strange assortment of tunes, in addition, such as Johnny Ray's "The Little White Cloud that Cried," "Release Me," and "How Great Thou Art."

BARRY ALLEN (Uni, 73104) sings and plays rhythm guitar on an 11-tune LP that bears his name as title. He has a high, distinctive voice—but it doesn't seem to say much. His bag, it appears, is schlock rock, so put him down as a newcomer who deserves a touch of oblivion.

TASTE OF FREEDOM (MGM, SE 4736) is jazz-rock by pianist Monty Alexander, who translates hit tunes into the jazz idiom. He has talent to burn, but to make it big will have to remove the copy-cat riffs borrowed from established stars. Best of the nine tracks are "Glory, Glory Hallejuah," despite it being rock 'n' roll of the old school with superimposed elements a la Erroll Garner; "Big Yellow Taxi," with its Latin rhythms; "Gingerbread Man," "Close to You," "Let It Be," "Something," and the title tune.

STEP TO JESUS (Volt, VOS-6013) is that good, old gospel sound, 11 cuts worth. There are elements of straight soul, and rock too, but mostly it's strictly Black church sound as performed by the Christian Tabernacle Concert Choir under the direction of Rev. Maceo Woods. There are 32 singers, all with vitality.

LIZARD (Atlantic, SD 8278) is King Crimson's latest, eight cuts that showcase fascinating if often obscure lyrics. The music combines jazz, rock, and classical strains—and also includes a lot of gimmicky stuff. The appeal is obviously to a mind-blown audience.

CABOOSE (Enterprise, ENS-1015) is a six-person outfit that has Gary Johns doing the lead vocals in a rough-and-tumble voice. Blues and soul is the mainstay, but there's good sound variety in the 11 tunes. Tempos and moods change also. Unfortunately, the overall result lacks that intangible extra to really groove with.

NEW TESTAMENT (United Artists, UAS-6796) finds The Ventures, previously an instrumentals-only ensemble of five, venturing into wordland. They should stick to their instruments. The dozen cuts are peppered with half originals, breaking the quintet's 10-year tradition of imitating other people's hits. The non-originals include Tito Puente's "Oye Como Va," Cat Stevens' "Wild World," George Harrison's "What Is Life," and Paul Anka's "She's A Lady."

THE WARM TOUCH (RCA Victor, LSP-4481) spotlights Harry Belafonte with a bunch of ballads and a tone reminiscent of, you guessed it, early Belafonte. There's softness, sex and blues in his voice. Best of the 10 entries are "Cycles," which, although a bit too slow perhaps, captures a mood of melancholy, and Joni Mitchell's "Circle Game," with a similar effect.

WHERE DO I GO (Quad-MGM, QUS-5003) showcases the 24-year-old regular from video's "Love American Style," Richard Williams. Among the 10 tracks is his hit "Till Love Touches Your Life." Although Williams *can* sing in a variety of motifs, his voice deserves no raves. Highlights include "Sun on a Tuesday Afternoon," a powerful opus with excellent orchestral and choral background, "Heaven Help Us All," a rousing spiritual-type, and the title tune.

MAMA, MAMA, LET YOUR SWEET BIRD SING (Epic, E 30413) provides eight cuts by Chelsea Beige, a sextet that seems bogged down in redundant phrases and routine rock. Arrangements are by lead singer Allan Springfield, who also penned the tunes and plays piano, and Kenny Lehman, who sings in the background and plays sax and clarinet.

FIDDLER ON THE ROOF GOES LATIN (MGM, LAT 10,013) is a re-release, as part of MGM's "Latino Series," with a dozen cuts combining the best ethnic themes from the Jerry Bock and Sheldon Harnick musical and the best south-of-the-border beats of Joe Quijano and his band. Born in 1935 in Puerto Rico, Quijano, who sings vocal accents and does narratives too, plays timbales, bongos, guiro, claves, and maracas.

FEEL THE WARM (Enterprise, ENS-1017) contains the familiar sliding, somewhat creaky voice of Billy Eckstine, who's been around *forever.* Stylistically unique, the singer performs one of his own creations (penned with Bettye Crutcher), "Third Child," good mod-ern soul with a touch of humor, and nine other tunes. The melodies are today, but Eckstine can't help being yesterday, even with background assistance from the Sherlie Matthews Singers. Among the more palatable items are "Walk a Mile in My Shoes," "We've Only Just Begun," "Love the One You're With," "Don't Leave Me," and "Mixed Up Girl."

GREEN IN THE GREEN (Harmony, H 30408) is a budget-priced disc featuring The Clancy Brothers and Tommy Makem on nine songs originally cut in the 60s. The reissue offers melodies in the Irish folk tradition that, unfortunately, is now out of favor. 'Tis a shame, for today's youth is missing something by overlooking this kind of thing—music taken seriously (not ultra-seriously) but still filled with fun.

ELECTRIC TOMMY (Viva, V36025) is an interesting approach to the first rock opera. Arranger-producers Joe Renzetti, who plays the guitar, and Tony Luisi, the keyboard ace, aided by Jim Valerio on drums, emphasize the musical qualitites of The Who's masterwork and keep the electronic gimmicks to a minimum. Ergo, it works well, becoming imaginative and melodic (and only a wee bit eerie).

FROM MONTY WITH LOVE (London, XPS 585/6) is a two-disc package with 22 cuts by Mantovani and his orchestra. The first vinyl contains all pop numbers (the best of which are "Try to Remember," "My Prayer," "Theme from 'Love Story'," "Little Green Apples," and "Where Have All The Flowers Gone"); the second stresses classical and traditional folk themes (including "Swan Lake Theme," "Mexican Hat Dance," and "The Blue Danube"). Lush and lovely.

ARETHA LIVE AT FILLMORE WEST (Atlantic, SD 7205) has the queen of soul singing 10 tunes that ring with excitement. Included is her recent hit "Bridge Over Troubled Water," which in virtually no way resembles the original Paul Simon and Art Garfunkel song. Also present are Otis Redding's "Respect," two creations by Aretha herself, "Dr. Feelgood," penned with Ted White, and "Spirit In The Dark," performed twice, once with Ray Charles, who was plucked from the audience, in gospel-reprise style, Lennon-McCartney's "Eleanor Rigby," and Stephen Stills' "Love The One You're With."

JAZZ & BLUES

NEWPORT '71: FESTIVAL UNDONE!

MARTHA SANDERS GILMORE

THE SEVENTEENTH Newport Jazz Festival in 18 years bloomed thrice blessed, first by the weather, the best in Newport history, then by Father O'Connor, who oversaw it all in the capacities of M.C. and mediator, and by a bandstand of jazz greats ranging all the way from four big bands to the New York Bass Violin Choir and the vocals of Dionne Warwicke and Roberta Flack.

Ubiquitous blobs of mist and fog had cast a shroud over the seaport the day before, only to be burned off Friday morning by an undaunted sun which blasted its way into Newport jazz history.

Up and down the bluffs encircling Festival Field were young campers, staking out their territories with red, white, and blue for it was the Fourth of July. Police had permitted them to catch the sounds from a woodland outpost at the base of the old World War I War Tower and word had spread through the underground press and via a pamphlet issued by the Potemkin Bookshop in Newport—a teaming motherlode of do's and don'ts for the nomadic youth—that "The hill's the place!" And, it was.

In anticipation of the thousands of ticketless onlookers, twelve Altec-Lansing speakers floated high across the stage rafters in an effort to appease the audience outside the gates. The sound was fine outside; the details carried well. Bostonian Bob Bennett, George Wein's sound man since about 1967, is a staunch advocate of controlling the sound on the hill, considerately setting the speakers tip-top. Bennett's sound system also includes two-cell No. 203 horns and two 1003 horns which are set on either wing of the stage. In addition, six A7 speakers are located at the ends. Bennett uses McIntosh amplifiers and is in favor of doubling the sound level in the future to accommodate the tremendous crowds.

Far down on the field on Friday evening, the festival began softly with the Dave Pike Set, playing lithe and lilting music in a Latin vein. Vibist Pike, who has resided in Germany for some time, had with him three German musicians who translated jazz to a fine turn. An electronic, space-age quality permeated their style and tune titles ran from "Attack of the Green Misers" to "Send Me the Yellow Guys." One wished however that they had all come down to earth in unity and cohesion.

The Stan Kenton Orchestra, minus their inimitable leader who was ill, produced that shimmering, wavering, woody sound that only trombones and percussion can impart, a music rampant with splayed, drawn-out notes and congas. Intermeshing tensions and dissonances were implicit in arrangements by Bill Holman, Johnny Richards, and Ken Hanna, but the latter's "Macumba Suite" could use some more polish. Kenton was M.C. at the original festival held in 1954 at the Newport Casino, and it was good to welcome the band back to Newport!

Perched high astride his set was brawny, blustery Buddy Rich, who is to the drums what Picasso is to art, Shakespeare to literature. Although we were disappointed that Rich submitted no new material this evening, he was great nonetheless—hot, grinding, and bumping, exorcising Indian rhythms with rim shots that had the crowd out of their seats. Saxophonist Pat LaBarbera continues to be brilliant in "Groovin' Hard," and we'd like to mention pianist Bob Petersen who utilized 200% of the keyboard, getting off some plunky bass chords that compelled even Rich to turn and listen. Rich was generous in his attacks and gave the fans a machine-gun drill solo that tapered to a whimper, then flared up again in an all new version of "West Side Story."

Duke Ellington's appearance proved lacklustre and anticlimatic. The band was relatively uninspired in "Brava Toga," "Afro-Eurasian Eclipse," and a segment of his "New Orleans Suite," but "Take the A Train" briefly cantered with barking brass. To top it off, fans were exposed to the calisthenics of vocalists Nell Brookshire and Tony Watkins who caused the Duke to mysteriously disappear.

To complete an only mediocre opener for Newport '71, Roberta Flack took the stage, giving vent to her rich contralto intonations but singing all too many didactic ditties. We'd like more music with less message! However, toward the end she revved up and all was forgiven for a scintillating performance of "Reverend Lee" and a hushed "Bridge Over Troubled Water." Roberta has true artistry and excellent technical control and Friday evening happily ended on the up beat.

And after all this, we heartily commend the Bob Bennett sound system at the '71 Newport Jazz Festival.

Saturday: Mountain weather once again.

The highways were studded with hitchhikers trailing puppydogs. The youngsters on the hills outweighed those inside the gates. Incense was in the air and a hefty breeze blew its spicey fragrance about the field where it mixed with the inevitable aroma of pot.

The timeless aspect of afternoons at Newport are conducive to improvisation. Today was no exception. Eubie Blake, 88 years young, launched the Newport balloon with kitten-on-the-keys phrasings of his own compositions, "Memories of You" and "I'm Just Wild About Harry." Blake, a stride pianist who once played for Newport millionaires and who composed the first Charleston rag in the 1890's, romped about the ivories, having no trouble with "Troublesome Ivories," his hands flying to and fro. Stomping his foot in time like a bass drum, he ripped off his own version of "Merry Widow Waltz" and beautifully embellished Cole Porter's "You Do Something To Me."

As if this weren't enough, the delightful Blake was followed by Willie "The Lion" Smith and his pupil, Mike Lipskin, who has learned his lessons well. "The Lion," dapper in bow tie, derby, and cigar, fussed around with "Chopin Fussing with Chopin," à la bravura school, infiltrating the keys with puns and quips and strains of the Polonaise. Smith sounded like a music box and, in a no nonsense fashion filled with nonsensical wicky wacky woos, finished with "Hot Ginger and Dynamite."

The hulk of Charlie Mingus bent over his bass like a huge pear first caught our eyes, then filled our ears with his wayward imaginings, his vast musicianship. The Mingus Sextet played straight-ahead jazz with Monkish musical ingredients in "Pithecanthropus Erectus," tempos changing, tempos mixed together. Mingus the genius, directed with a wide sweep of the arm and occasionally a fist, having fun with "Cocktails for Two," slapping his bass, putting us on. Lonnie Hillyer decorated it all with a Clyde McCoy mute. It was rinky-tink and right, and Mingus actually smiled.

The cool, chic strains of the Freddie Hubbard entourage carried us down to the cellar, Hubbard's warbling cascade of notes drifting off down what seemed to be an endless rabbit hole of cone-shaped tones. In material from their recent albums, Joe Bonner was spooky on electric piano, evoking the spirits, toying with them, while Hubbard freely bent notes on trumpet.

Roberta Flack

Gerry Mulligan

Photos by George Gilmore

A mesmerizing and contrasting set ensued by the New York Bass Violin Choir directed by Bill Lee. No less than seven bassists plucked and bowed through a set of folklore descriptions of life in Snow Hill, Alabama. Bill Lee was bassist, singer, and narrator all at once and was resonant at all three endeavors, enacting the lyrics to the extent of hobbling across the stage on a crutch at one point. It was a dark and cavernous music which approached the sound of a full orchestra. Reminiscent of Gershwin and John Lewis, it went on a bit too long but remained an unforgetable experience for a Newport audience. According to Lee, the entire effort will soon be recorded.

The sophistication of Ornette Coleman enlarged and ended a winning festival afternoon. Coleman, in watermelon-red suit and white sandals resembling spats, played his singularly organic brand of unstructured but disciplined music, enjoying the timbres of three instruments on a seance in July. Coleman played trumpet, saxophone, and violin, taking honors in all three classes with Charlie Hayden playing the very strings off his bass and stomping the wah-wah-pedal. The density of it all was beguiling on a Saturday of geniuses—a Saturday of bassists!

The evening began only an hour later, the afternoon sun sinking low over the Newport Bridge. The firecracker-hot jazz-rock group Chase led off, headed by trumpeter Bill Chase out of the Berklee School. A walrus of a singer was Terry Richards, and the group performed with enthusiasm and verve.

Then, back to tradition we went with Gerry Mulligan and Dave Brubeck. Mulligan, who has grown a Father Time beard, played a craggy. leggy baritone, horsing around in the lower register, piping out a hornman's dream. But Brubeck never got away from a monotonous array of hammerlock chords which sounded like someone hitting a tennis ball against a backboard.

Off went the lights and Dionne Warwicke's supple voice rang out over Festival Field in "Close To You" and scads of tunes from her usual Bacharach-David songbook. She built to the skies in a medley of some twelve songs, the audience really digging it

until George Wein's wife came on-stage and whispered to Dionne. One felt a surge of tension when Wein himself momentarily announced that the remainder of the performance had been cancelled, requesting that the audience calmly leave the field. In an emotional voice, Wein said that the police outside the field were using tear gas: The situation was serious.

Immediately, youths banded together in defiance of Wein's "non-establishment" in a ploy not to leave, but the bulk of the crowd filed out, disappointed to miss Mary Lou Williams and a jam session featuring Jimmy Smith.

As had happened two years ago, the kids had crashed the gates, plummetting over them like a waterfall, shouting "Come on in, folks, the festival's free." But, this year, after the initial ambush, they continued the holocaust up on the stage, chanting and whooping like Wild West Indians, breaking chairs, climbing the rafters, hurling microphone stands in a senseless destruction of the last remaining outdoor festival on the East Coast. In addition, they tossed about Socialist pamphlets entitled "Young People Have Good Reason to Rebel" and "How To Build a Sane World." One concludes that the disturbance must have been organized. Father O'Connor tried to placate them, Mulligan said "Cool it," but the ballyhoo continued for some four hours.

Early the next morning with less than half the festival completed the youngsters were asked to leave Newport. The authorities had cancelled the festival.

Jazz is producer George Wein's life, and he is determined to somehow continue the Newport Jazz Festival, structure unknown. But his path is uncertain, with such things to contend with as narcotics and over-population resulting in anonymity and rebellion.

One wonders what the young people felt they had accomplished in this frenzied disruption of America's only art form. One tries in vain to sort out the complexities that caused them to search for such distorted power and identity. What has America wrought? What will happen to our music if we cannot find a peaceful place to listen to it?

At dawn, the gulls were picking through the crumpled litter on the hills and field. Strains from the festival piano wafted through the emptiness, having suffered a few torn ivories and lost its casing. Miraculously, it still played. But Newport '71 was undone. AE

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STEREO TAPES (reels) 30-70% discount. Sokol, 3237 South Manor, Lansing, Ill. 60438.

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FOR SALE: Stereo Components. Sansui amplifier TR 707A; Sansui stereo headphones SS-2; AKAI X-100 D solid state custom deck; Pioneer PL-41 stereophonic record player; Pioneer SR-101 reverbation amplifier; Pioneer CS-A31 3 way stereo speakers. Marvin K. Smither, 1285 S. Florissant Rd., Florissant, Mo. 63031 (314) 837-7572.

IMF "STATE OF THE ART" speakers; Decca cartridges; Jans "Z" en electrostatic speakers; PML headphones; Goldring cartridges; we also have some mint condition used equipment. Audiocraft, South Rockwood, Michigan 48179. Telephone evenings (313) 379-9945.

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TEAC Corporation of America Erath models LWE-I and LWE-VI speaker systems. Heathkit AJ-15 Deluxe stereo tuner. John Barrett, P. O. Box 207, Immokalee, Fla. 33934.

CASH FOR YOUR unwanted LP's and prerecorded tapes. Record House, Hillburn, New York 10931.

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(Continued on page 82)

Classified

(Continued from page 81)

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OCTOBER 1971 ISSUE

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OCTOBER 1971 60c

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LONDON LETTER

SPECIAL ISSUE ON

QUADRAPHONICS

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