

THE B.A.S.

The Boston Audio Society  
P.O. Box 7  
Boston, Mass. 02215

June  
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SPEAKER

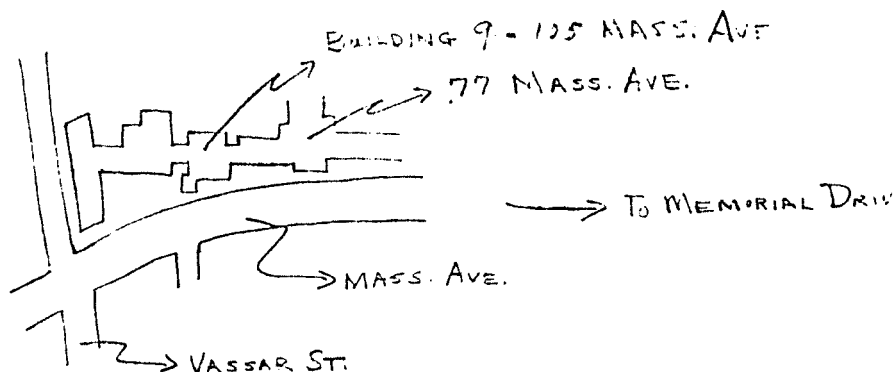
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June meeting. The next meeting of the B.A.S. will be held on Sunday June 17. It will start at 2:00 pm to accommodate our guest speaker, a member of the Nakamichi family, who will discuss and demonstrate the new Nakamichi Tri-Tracer 1000 cassette deck. Featuring separate record and play heads, this deck appears to be the first significant advance in cassette recorder design since the Advent 201.

Our regular meeting room will be unavailable, so the June BAS meeting will be at M. I. T. in Cambridge, in Room 150 of Building 9.

Building 9 is entered via a revolving door at 105 Massachusetts Ave. Room 150 is the Auditorium on the ground floor--the door to the room is at the rear of the building. We will attempt to have signs to direct you to the room.



LM 381A ICs. After much delay by National Semiconductor, Al Southwick has received a partial shipment on the BAS group purchase of LM 381A low-noise ICs for use as phono, tape, or mike preamps. Enough of them came so that each member who placed an order will get at least one; get them at the June meeting.

Bulk purchase of tape. We are preparing to order a bulk lot of blank tape to supply both the Dubbing Committee and individual members who wish to participate in the purchase. Come to the June meeting prepared to (1) vote on what brands and types of tapes (and cassettes) we want and (2) place a firm order for as many reels as you want. The price of low-noise tape will be about \$3.50 per 1800-foot reel, versus \$5 average retail.

BAS Telephone List. Most of the BAS members who returned the Questionnaire indicated a positive interest in group activities outside of the monthly meetings, and very few objected to inclusion in a circulated membership list, so we plan to publish a list of BAS members. The list will include phone numbers but not addresses. Since the questionnaire was anonymous we don't know the names of those who don't want to be included. If you do not wish your name and phone number listed in the roll. (which will be part of the July mailing to BAS members), please let us know right away. Either mail a note (Box 7, Boston 02215) or notify us at the June 17th BAS meeting.  
-- The executive committee

BAS Publication. A very thorough comparison of three good tape decks, including a discussion of some aspects of performance which are not usually considered in test reports, is the subject of this month's BAS publication, written by Alvin Foster. OCR from mimeographed copy: may contain errors

ReVox group purchase. Marty Gasman hopes to place the BAS group order for ReVox tape recorders with an English dealer around the end of June, so place your firm orders with him at the June meeting. The price will be about \$520 including shipping, customs duties, alignment, and biasing, compared to a local cost of about \$825. In view of the results of A1 Foster's test report on tape recorders, this will be a major bargain.

Tape Dubbing. We have received a note from a gentleman who has been taping BSO broadcast concerts off-the-air since the 1950's, using a Marantz 10B tuner and a studio Ampex tape deck. He has offered his tapes for dubbing, so if you want an old favorite BSO concert, send your request to the BAS Dubbing Committee. The price, as announced previously, is the cost of the blank tape (about \$3.50/reel typically) plus a \$2.00 service fee. You will find the 1973 WCRB Marathon Guide a useful guide for finding and specifying performances and dates; it is available at BAS meetings.

Advent tour. Andy Petite has generously renewed his offer for a guided tour of the Advent plant in Cambridge, on a week-day to be chosen. Attendance will be limited; sign up at the June 17th meeting.

Publicity. Thanks to A1 Foster, the BAS received favorable mention twice in the May 1973 issue of Audio magazine. As a result we have received numerous inquiries and several paid applications for membership, some from distant parts of the country.

Imported records. Dave Letterman's BAS Record Importing Service has sent its first order (totalling about \$150) to England. If you would like to participate in the second order of European records unavailable here and superior British pressings of EMI/Angel records, place your order with Dave. at the next BAS meeting or mail your order (with a check payable to David Letterman) to the BAS mailbox. When the records arrive they will be delivered only at the next following BAS meeting. In general, "full-priced" European records such as the EMI originals of Angels cost \$4.60. Middle-priced and budget labels are also available for about \$3.30 and \$2.50 respectively.

Shop Talk. Several respondents to the BAS Questionnaire asked for seminars for beginners to discuss basic mysteries such as how loudspeakers work, how the stereo record groove works, etc. Answers to such questions can be found in books and in back issues of hi-fi magazines in public libraries. In addition, discussing such questions is supposed to be one of the functions served by "Shop Talk," and since the BAS grew out of Shop Talk we have assumed that all BAS members are at least aware of the program if not regular listeners. It has come to our attention that some members are not aware of it, so we take this opportunity to call your attention to Shop Talk, an. informal and free-wheeling 9.0-minute discussion of audio hosted by Peter Mitchell and Dick Goldwater and broadcast every Saturday morning at 9:30 on WBUR-FM (90.9). If you are quick with the phone you can ask on the air any question which may occur to you. The technical level varies from quite basic to moderately abstruse; the July 7 and August 4 shows are planned to be introductory. The June 16 show will probably feature RCA producer Max Wilcox.

Adventures in Sound. Here is the revised schedule for Victor Campos' program on WGBH (in which he plays master tapes Sundays at 3:30) for the remainder of June.

- June 10. Gottschalk: Gran Tarantella for Piano and Orchestra (Abravanel; Vanguard)  
 Beethoven: Concerto in D Op. 61, arr. for Piano and Orchestra (P. Serkin, Ozawa; RCA)  
 Gould: Latin American Symphonette (Abravanel; Vanguard)
- June 17. Discussion with RCA producer Max Wilcox.  
 Tchaikovsky: Nutcracker (excerpts) (Ormandy; RCA)  
 Tchaikovsky: Romeo! and Juliet (Ormandy; RCA)
- June 24. Vivaldi: The Four Seasons (I Solisti di Zagreb; Vanguard)  
 Tchaikovsky: 1812 Overture (Ormandy; RCA)  
 Haydn: Symphony #60 "Il Distratto" (Blum; Vanguard)

The program will go off the air at the end of June. It may return in the fall. The address for postcards is WGBH-FM, 125 Western Ave., Boston 02134.

Hot Tips Dept. N. E. Music City is phasing out the classical inventory in all of its stores (even at the Pru. ); this is a tragedy and letters might help. Cramer's has a flock of open-reel cut-out tapes on the DGG label at \$3.98/reel, including some particularly good buys in opera.

Sight and Sound at 173 Cambridge St., Boston (on the Charles River Plaza, 523-5195) is closing out non-Dolby Ampex (DGG, London, Angel) tapes for \$3.99 or \$2.99 per record equivalent, lower for opera. The opera tapes can be particularly good deals (e.g., Siegfried on London for \$8.98) but supplies are very limited and not predictable.

-- Harry Zwicker

Tape Saturation. As an adjunct to my test report on tape recorders published with this issue, I measured saturation in open-reel and cassette machines. A 400 Hz sine-wave signal was used because it fairly represents the bulk of most musical program material. This was confirmed after observing a 1/3-octave real-time analyzer being fed various types of program material. The frequency selected is important because saturation effects vary with frequency.

With a half-track ReVox. saturation at 400 Hz did not occur until a level of 12.5 db above 0 VU. With an input level of +13.5 VU the output signal was +12.5 db, down 1 db. At 50 Hz the playback level from the tape was down 1 db at only +9 VU. High frequencies are especially brutal, for example a 15 kHz signal on playback is down 1 db at an input level of only 0 VU.

Using the 400 Hz signal I tested two cassette recorders, a Sony TC 160 and a Teac 210. Saturation set in at much lower levels than with the ReVox. Using an Advocate Crolyn C-60, the playback level was down 0.5 db at -2 VU with both recorders. At 0 VU input; the tape level was down 0.8 db and at +2 VU the output level was down 1 db. Using iron oxide tape or thinner CrO<sub>2</sub> cassettes made the situation worse. The output level from a Maxell iron oxide UD C-60 was down 1.4 db at 0 VU and down 3 db at +2 VU input. A BASF CrO<sub>2</sub> C-120 cassette was down 1.3 db at 0 VU and down 3 db at +2 VU.

In the test for record amplifier clipping using Advocate Crolyn C-60's, both cassette recorders exhibited such a distorted 0 VU waveform that it was extremely difficult to separate record amplifier clipping from other non-linearities due to tape saturation. (This is in contrast to the open-reel recorders which exhibited nearly clean waveforms up until actual clipping of the recording electronics had started to occur.) It appeared that the Teac 210 clipped at +2 VU while the Sony TC 160's clipping point was about +6 VU.

These measurements confirm my experience that the proper recording level for my TC 160 cassette deck is -10 VU maximum! -- remembering that musical peaks are at least 10 db above the RMS indication. You can confirm this for yourself by recording Bill Pierce's voice from WGBH on your cassette. The maximum recording level is that point at which all traces of distortion are no longer present in his voice. These results show that the careful choice of recording level is more critical with cassettes than open reel. -- Alvin Foster

Cutting your own. Most of us have tape recorders and can make our own recordings without having to rely on pre-recorded tapes. But when it comes to disc recordings we all rely exclusively on commercially manufactured platters. That restriction may not be necessary. We have received a letter from Albert R. Jourdan, 438 Wall St., Meriden, Conn., 06450, who has his own mono disc-cutting equipment and has contacts with several other hobbyist record-cutters around the country. He will willingly exchange information with anyone interested or involved in disc-cutting.

May Meeting. An overflow crowd of about 85 members and guests, including several well-known speaker designers, convened on May 3rd to see and hear the Heil speaker. In the open-forum portion of the meeting several members reported favorably on their comparisons of the Audio Technica AT-11 versus such competitors as the ADC XLM, ADC 26, and Shure V-15 III. Members who attended the April concert of the Boston Philharmonia at the National Theater in the Boston Center for the Arts noted the excellence of the hall's acoustics -- as good in some ways as Symphony Hall. (Al Southwick recorded the concert.)

The featured part of the meeting was a discussion and demonstration of the new ESS/Heil loudspeaker, presented by Dr Oskar Heil, Philip Coelho (V. P. of ESS), and Robert Ur (ESS distributor). Dr Heil, a physicist, discussed the speaker in terms of the physical ideas underlying its development. The conception of it lay in the realization that conventional electro-motive devices can push air with a great deal of force but cannot propel air with any velocity faster than that of the moving diaphragm (the speaker "cone"). Air, being lightweight stuff, doesn't need much force to push it, so in conventional speakers much more energy is used to move the diaphragm than is actually imparted to the air. Not only is this inefficient, but the energy imparted to the diaphragm can stimulate mechanical resonances in the material ("cone breakup"), producing sonic colorations which are difficult to control.

The Heil speaker, on the other hand, incorporates an "air motion transformer" which transforms air motion at high force and low velocity to produce air motion with low force and high velocity. It is analogous to an unequal-armed see-saw on which a large weight (force), moving only a little at the short end, can swing a small weight on the other end through a large distance. This is accomplished by using the electromagnetic energy to push the sides of U-shaped channels together with high pressure, squeezing the air out of the ends of the channels in a rush. The air motion being 5 times greater than the motion of the diaphragm (the sides of the U-channels), the speaker is relatively efficient. The walls of the microscopic U-channels have conductive stripes which carry the current, and the device is placed in a magnetic field; the interaction between the current and the

field provides the force to alternately squeeze and expand the U-channels, just as the interaction between the current in the voice coil and a fixed magnetic field provides the vibrative force in a conventional loudspeaker. The present Heil unit is a midrange-tweeter (500 Hz to 23 kHz); since the magnet structure disperses the sound uniformly at all frequencies in its range, and since the air-squeezing action is uniformly efficient, the system has a flat acoustic power output over its range. Since the diaphragm material is light and the driving force is applied uniformly all over the diaphragm, resonances are minimized, and coloration and distortion are low. Dr Heil has also designed a woofer using similar principles but different construction, so a full-range Heil may appear next year.

The Heil AMT-1, which employs a conventional woofer, was demonstrated. Evaluation was limited by a lack of good source material as well as by the room acoustics; judgement of its sound awaits home trials and (more interestingly) the eventual full-range version. However a recording of Jose Greco doing a flamenco dance on a table showed that the speaker is capable of propagating enormous amounts of high-frequency energy and has stunning transient response. Levels in excess of 120 db appear to be attainable without straining either the speaker or the amplifier being used. This may not be an obvious virtue with Mozart symphonies but it is undeniably vivid.

Used Equipment: In the last issue of the newsletter a complete list of used equipment appeared. Since Joel Sandberg is leaving the area, we will temporarily handle the listing via the P.O. Box, so if you are interested in any items listed, drop a card to the P.O. Box and we'll send you the name and phone number of the seller.

In the future we will accept short want-ad type listings for the newsletter. These ads should include pertinent descriptive information as well as a method for the prospective buyer to reach you (phone number or address). Ads will appear once unless we are specifically requested to repeat them for a second month.

For Sale  
 Marantz 7C  
 Contact Jeff Gold  
 267-4798  
 Good price

## REPORT ON THE B. A. S. QUESTIONNAIRE

Nearly half of the B.A. S. membership returned the April questionnaire, and a valuable result is that several of the 34 respondents took advantage of the open space for "your suggestions" to discuss some excellent ideas for projects which could benefit us all.

In question 1 we asked what group activities you would actively participate in, outside of the BAS meetings. The number who checked each activity are listed below.

4 Opera (discussing & listening)	2 78-rpm records
20 Symphonic music	9 Tape dubbing swapping
10 Chamber music	12 Live recording
15 Baroque music	19 Equipment test clinics
8 Modern music	19 Evaluating cartridges
6 Electronic music	14 " tuners
4 Folk music	15 " recorders
6 Jazz	12" amplifiers
2 Rock music	21 " speakers
11 Kit construction/repair	12 " accessories

Eight members suggested "other" activities: collecting/trading hi-fi magazines, evaluating microphones, evaluating new records, design and construction of original circuits, improving automotive radio, and a seminar for "real beginners."

Most of the people who checked baroque or chamber music also checked symphonic, and some checked all three. Evidently there is a real interest in groups getting together for the specific purpose of listening to classical music; rather than discussing audio. This is, of course, the purpose of the many Gramophone Societies in England. There also appears to be solid interest in joining/sharing with others the experiences of kit-building, tape dubbing, live recording, and evaluative comparisons of equipment (especially speakers and cartridges). The executive committee obviously cannot be the organizing focus of all these activities. We suggest the following approach for your consideration.

Question 1 will be distributed again at the June meeting, but this time on a non-anonymous basis with a space for your name and phone number. (If you can't come to the June meeting, send us a post-card naming the activities you want to be involved in.) Then in the July newsletter we will list the members interested in each group activity. If you are involved in live recording, for example, you will know who shares your interest; you can contact each other and exchange information on recording opportunities, microphone evaluation, etc. Or if you are into chamber music, the list will tell you who else is actively interested in group-listening and discussion. The value of this (or a similar) mechanism for identifying members who share our interests is emphasized by this quotation from a returned questionnaire: "I've gone to almost every meeting and still know only 3 or 4 members well, which is quite sad."

The results of questions 2 through 9 are summarized below. The (?) entry indicates either no response or a response indicating that the member was uncertain.

2. Object to a circulated BAS membership list? Yes 15% No 85% (?) 0%.
3. Object to being in a mailing list for ads, subscription offers, etc.? Yes 30% No 70% (?) 0%.
4. Do you save the BAS "Speaker?" Yes 88% . No 12% (?) 0%.
5. Do you save the BAS Publications? Yes. 100% No 0% (?) 0%.
6. Want a BAS library? Yes 62% No 23% (?) 15%.
7. Should BAS buy test gear? Yes 21% No 50% (?) 29%.
8. Did or will you write RCA? Yes 50% No 35% (?) 15%.
9. Did or will you write WGBH? Yes 68% No 12% (?) 20%.

Comments. Q.2: Several members objected only to circulating addresses but approved a list of members' names and phone numbers. Q.3: Since nearly a third of BAS respondents oppose it, we will not give or sell the BAS mailing list to stores or magazines in exchange for names of potential new members. Q.4 and Q.5: In view of the response, the BAS officers will continue to devote a large measure of their time to producing a high-quality newsletter. Q.6: There appears to be sufficient interest in it to justify establishing a BAS library, if volunteers can be found to man it and if the practical problems of location, access, and borrowing procedures can be worked out. Suggestions for its content include back issues of domestic and British magazines, basic books on audio and on music, service manuals and schematics, books on maintenance and repair, parts catalogs, mail-order discount house catalogs, an organized file of equipment reviews, and loose-leaf notebooks on various topics (each notebook containing a collection of the best articles on its subject, compiled from various magazines over the years). Q.8 and Q.9: In view of the small number of letters actually received from BAS members (according to Mr. Campos), the BAS is a goldmine of good intentions. But it is also clear that some definite anti-RCA feeling exists. Sample quotes: "With very few exceptions the only worthwhile RCA recordings are on their Victrola label!" On writing to RCA: "Am pessimistic that it would do any good --look at their track record!" "Ormandy doesn't turn me on, regardless of the quality of the tape recordings." "I don't care about quad if A & R is on the same basis as always. The major recording companies such as RCA and CBS are distinctly counterproductive in terms of their influence on the attitudes of the general public towards music and musicians. The few companies who make a point of promoting truly respectable performances of serious music don't get caught up in speculative schemes like 'surround sound' but rather spend their energies in fostering the art of music."

On page three of the questionnaire we invited you to review and rate the meetings, activities, and publications of the BAS. We tallied the results in two ways. First we tallied the ratings from all of the returned questionnaires, assigning a rating of zero in all cases where the activity was not attended or the publication was not read. The assumption here is that an unattended meeting or unread publication did not attract the member's interest and so did not serve him/her well. Of

course the assignment of zero ratings will lower the average rating of an activity that members were interested in but couldn't attend due to illness or conflicting commitments, but this downward bias probably affected each tally about equally. However, to provide another gauge of members' sentiment we retallied the returns, counting only the responses of the members who attended the meeting or read the publication. The results of both tallies are summarized below, with the items in each category listed in order of popularity. In the left column all returned questionnaires were used to derive rankings, including assigned zero ratings for unattended/unread items. The right column ranks items according to the members who attended/read them, with the number of responses given in parentheses.

#### Programs

Roy Allison (AR)	Laurie Coté concert (20)
Laurie Coté concert	Roy Allison (27)
Victor Campos (KLH)	Richard L.Kaye (20)
Rene Jeager (DBX)	Victor Campos (24)
Richard L.Kaye (BSO/WCRB)	Rene Jeager (23)
Andy Petite (Advent)	Andy Petite (21)
Al Southwick (BAS)	Mike Wargo (22)
Mike Wargo (Tech HiFi)	Al Southwick (21)

#### Activities

AR tour	AR tour (9)
Recorder test clinic	Recorder test clinic (7)
Newton Symphony playback	Newton Symphony playback (6)
Live recording seminar	Live recording seminar (5)

#### Newsletter features

Meeting reports	Meeting reports (24)
Recommended records lists	Non-BAS news (24)
Non-BAS news	Recommended records lists (26)
Used equipment lists	Used equipment lists (24)

#### Publications

Mitchell: Null Switch	Mitchell: Null Switch (27)
Goldwater: Audiophilia	Mitchell: Record Sound (25)
Foster: Tapes	Goldwater: Audiophilia (29)
Mitchell: Record Sound	Foster: Tapes (30)
Foster: Amplifiers	Foster: Amplifiers (26)
Boyer: Opera	Boyer: Opera (24)

Several conclusions can be drawn from the returns and members' comments. (1) Except for Dennis Boyer's introduction to opera which encountered some anti-opera feeling, recent BAS programs and publications resonate more warmly in BAS members than last fall's activities do. Perhaps the passage of time has dimmed the memory of last fall's pleasures, or maybe we have actually had more interesting programs and publications this spring. Possibly both. (2) Factory tours and test clinics are wanted and we should have more. (3) The experiment of having a live concert at a meeting was a distinct success and we should have more, perhaps twice a year. (4) The full-coverage newsletter which we have been producing is well-liked and should be continued. Finally, in interpreting the tallies it is worth noting that there was a great deal of scatter in the ratings; the relatively low-ranked items were enthusiastically received by some BAS members, and the highest-ranked ones were judged uninteresting by some.



Your suggestions and comments . Following are some edited excerpts from a few of the questionnaires.

How about a BAS record-rating service, similar to Consumer Reports Movie Ratings. Members are supplied with pre-addressed post cards (not postage-paid) on which they list the records they've purchased recently and a rating of recording quality and musical quality. Once the same record has been rated by 3 to 5 members, it is listed in the BAS "Speaker" with a summary of its ratings. As additional members buy and rate the record its summary rating would be updated. Once or twice a year the top records could be listed as a separate BAS publication with final ratings and selected comments by members culled from the cards. -- Chip Atwood

The scope of articles covered over the years by American and British hi-fi magazines is the best source of information available. If some time and effort could be spent in sorting out, selecting, and Xeroxing these articles for loose-leaf notebooks, a terrific reference library would be built up. -- Richard Akell

The three N.Y. hi-fi radio programs seem to be of little value. Brand-name comparisons are never made. The commentator is too polite to ask pointed questions. The shows are "non-controversial." Exchange of these shows for Shop Talk would seem to be a waste of time for the BAS Dubbing Committee. -- Steve Roth, N.Y.

Victor Campos' letter (on the apathy of BAS members) was a well-deserved kick in the pants. -- Keith North

We could write to some British Gramophone Societies for ideas and samples of their newsletters. -- Richard Akell

How about a poll of what equipment BAS members own and whether they are satisfied or not with each component. Then publish a tabulation of the equipment listed by 3 or more members, with ratings and comments. -- Chip Atwood

I would like to see more time devoted to the appreciation of music; the topics are endless, from conducting to individual pieces. -- Anon.

## B.A.S. GO-TO-TANGLEWOOD

Attached is a copy of the first version of the Tanglewood sign-up forms; any comments for the improvement of either the form or the organization for car-pool formation can be phoned or sent to Harry "Rick" Zwicker at the listed address. The forms are pretty much self-explanatory, as is the method used to help people get rides or fill their cars. Basically Rick will try to call all the people who either send in a filled out form, or who call in the information. He will exchange with them the first names and telephone numbers of the others also going to the same event. It will be up to you to call these people until you find a ride or until you fill your car as full as you desire. Rick will continue calling and exchanging information until he finds out that a car is full or that a person has found a ride or until all of the people going to an event know the numbers of all of the others also going.

You may also call to obtain this information or ask if anyone in your specific area of Boston is going, etc. He'll also relay any other information you put on the forms, e.g., if you would like to attend the weekend prelude, or attend a Saturday/Sunday pair, or buy tickets in a group, etc. If the number of people signing up for a particular event is extremely great, he will investigate the possibility of chartering a bus, although this will probably not occur unless the BAS decides to hold a "meeting" at Tanglewood some Sunday afternoon.

Note: Rick suggests that you call him at his work telephone number. Also, to limit the possibility of burglary, house addresses should be exchanged only between the drivers and the riders rather than on the sign-up forms (unless you wish otherwise).

Additional copies of the sign-up forms will be available at the June, July and August BAS meetings.

B.A.S. GO-TO-TANGLEWOOD

Day\_\_\_\_\_ and Date\_\_\_\_\_ of event.

Time you prefer to arrive in Lenox\_\_\_\_\_ (allow for prelude, open rehearsal, picnic on the lawn, etc.)

Time you prefer to leave for return trip\_\_\_\_\_ And date\_\_\_\_\_

Number of people in your party\_\_\_\_\_

Maximum number of remaining spaces left in your car\_\_\_\_\_

Your town or area of Boston from which you will be leaving or from which to be picked up:\_\_\_\_\_

Your telephone #\_\_\_\_\_ Best hours\_\_\_\_\_

Alternate #\_\_\_\_\_ Alternate hours\_\_\_\_\_

Your first name

Have you purchased tickets?\_\_\_\_\_

If not, would you want to form a. group?\_\_\_\_\_ Price range

Other comments (e.g., would you plan to stay overnight or attend more than one event, etc.)

I will contact all those signed up for an event to relay the above information; all those going at compatible times will know the names and numbers of all others also going at least two days before the event, unless the others find a ride or fill their cars first. call me anytime before the event to obtain this information, if you prefer not to wait for my call.

Mail this form to -- Harry "Rick" Zwicker, MIT Lincoln Labs  
P.O. Box 73, Lexington, Mass. 02173

or call in the information at 862-5500 x5811 (days)  
or 275-2175 (evenings and weekends)

— (do not write below this line) - - - - -

Number\_\_\_\_\_ 1 2 3 4 5 6 7 8 9 10 11 12

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### A B.A.S. Test Report

Revox A77III, Braun TG 1000, Teac 3300

by Alvin Foster

Before purchasing an additional piece of equipment, the dedicated audiophile will plow tirelessly through comparative test reports, leaf through piles of magazines, and engage in numerous conversations with "those who should know" about the equipment he is about to purchase. Yet after all the laborious searching, with the often conflicting goals of obtaining the highest quality, the greatest flexibility, and the best sound all at the lowest price, enough differences in opinion remain to support more than fifty speaker manufacturers, dozens of amplifier designers, and enough turntable manufacturers to spin cotton in Georgia at 33 1/3 RPM.

This report compares in detail three top tape recorders in an attempt to clarify some of their differences. The three tape recorders are the ReVox Mark III (current price \$800), the Braun TG 1000 (\$875), and the Teac 3300 (\$500). The Teac is not in the same price category as the ReVox and Braun but its features make it a serious competitor. I obtained two samples of each of the three models. The six recorders had been used extensively by their owners, but except for one of the Brauns each was less than a year old. In contrast with the samples used by most magazine reviewers, none of these recorders was provided by the manufacturer for testing. Except where otherwise specified in this report, the two samples of each model performed alike.

Frequency response. I measured the frequency response at -20db for each machine as delivered. Four of the six recorders exhibited poor response, with deviations of up to  $\pm 6$ db in the audio range from 30 Hz to 15kHz. It would not be informative to publish the curves because each of the recorders with proper bias and equalization settings is capable of a flat response within  $\pm 2$ db from 30 Hz to 15kHz. The lesson to be learned from this is: if you plan to engage in serious recording, you should have your recorder adjusted for the tape you use by a competent shop (or better yet, do it yourself); then have its performance verified by an independent recorder test clinic. If you don't have these adjustments made, the machine is probably not meeting its specifications.

Signal-to-noise ratio. To test for S/N ratio, I first played a standard level tape, Ampex Alignment Tape #4690010-01, and noted the output signal level (on an AC-VTVM) which corresponded to the 0 VU reference value on the tape (185 nano-Webers/meter). I then recorded on a bulk-erased 7" reel of BASF LP-35 LH tape with the record volume controls set at their minimum positions. The playback output level was measured, and its' ratio to the 0 VU output level, expressed in db, is the unweighted S/N. Thus to say that the S/N is -45db indicates that the unwanted hum and hiss of the recorder is 45db below 0 VU.

The following results were measured.

	<u>Right Channel</u>	<u>Left Channel</u>
ReVox	52.0 db	55.0 db
Teac	51.5	54.0
Braun (bought 1/71)	47.6	45.6
Braun (bought 1/73)	43.6	41.1

The owner of the 1971 Braun complained to the company about the audible hum. The service representative modified the machine but according to the owner the problem still exists, as these measurements confirm. I had been told that the newer model Brauns do not have a hum problem, but the S/N measurement of the unit purchased in early 1973 suggests that hum is still a problem.

Headroom. While the S/N test describes the useful dynamic range below 0 VU and indicates how much the noise may interfere with quiet musical passages, the headroom test measures the useful dynamic range above 0 VU to accommodate signal peaks. In a recorder with poor headroom the peaks will be distorted unless you lower the recording level (which would push the quiet passages down into the noise).

Test labs usually measure headroom by measuring the signal level which produces 3% harmonic distortion. But this is inadequate because the audible effect depends on whether the distortion is due to tape saturation or "clipping" in the recorder's electronics. The clipping behavior exhibited by the recorder's electronics is more audible and distressing than the more gentle distortion produced by tape saturation at these levels. Clipping is a form of waveform distortion in which the peaks of the signal are clipped or shaved-off. It is a very audible form of distortion, easily identified once you know what to listen for. Some audiophiles have suggested that the difference in the sound of various amplifiers which have similar specifications and power output may be due to the way the amplifier overloads or clips. They contend, and I agree, that "soft" clipping and fast recovery are important to good sound reproduction.

To measure the headroom of each recorder, an oscilloscope was connected to its outputs and both a signal generator and a meter were connected to its inputs. The signal level corresponding to 0 VU was noted, with the recording level controls at maximum. Then a 400 Hz sine wave was recorded on blank tape at successively higher levels until clipping was observed in the playback output signal. The signal level at which clipping just begins to occur, expressed relative to the 0 VU level, is the headroom.

I measured the headroom using BASF LP-35LH tape on each recorder; slightly different results might be obtained with other tapes. The following table includes results from two additional recorders for comparison.

ReVox	+13 db	Tascam	+ 8 db
Braun	+12.5 db	Tandberg 6000X	+10 db
Teac	+ 8 db		

The same tape was used on each machine, so these measured differences are due to the recorders rather than the tape. The tape begins to saturate at about +9db, but the tape distortion at this level is "soft," and clipping due to the tape would not begin until at least +12db. Therefore what i am measuring here is the clipping level of the electronics. In fact tests have shown this clipping to be occurring in the record preamps.

This test of record amplifier clipping in tape recorders has not been included in magazine test reports. But it is an important one which should be made a standard part of all recorder test reports, because record amplifier clipping is very audible. Differences in clipping level probably are partly responsible for the relative sound qualities of recorders at high signal levels.

As Rene Jeager of DBX demonstrated at a recent BAS meeting, music often has momentary peaks 10 to 15db above the indicated VU ("volume unit") meter level. For minimum listening fatigue, clean reproduction of these peaks is essential. The high headroom of the ReVox and Braun recorders also makes the setting of recording levels less critical; fairly good recordings can be made with the meter needles pegging well above 0 VU. But with the Teac and many other recorders, maximum indicated VU levels should be kept under 0 VU to avoid distorting peaks.

Of course the optimum recording level depends on the individual listener. With any recorder it is a good idea to make some trial recordings at various recorded levels and determine what is the best compromise for you between noise (at low levels) and distortion (at high levels).

The total useful dynamic range of a tape recorder can be obtained by combining the S/N and headroom measurements, since each is referenced to 0 VU. The results, averaged for the two channels, are as follows.

ReVox	66.5 db
Teac	60.8 db
Braun (1971)	59.1 db
Braun (1973)	54.9 db

Note that these values are not "weighted" to reflect the ear's varying sensitivity at low frequencies. Weighted values would indicate a larger useful dynamic range, especially for the Brauns.

Input overload. The measurement of headroom indicates the clipping level in the recording preamp just ahead of the record heads. Clipping in this stage can be avoided by holding down the recording level with the recording level controls. But in most recorders a large input signal can also be clipped in the input preamp before it gets to the recording level controls. So I measured the input overload level of the microphone and auxiliary inputs of each recorder.

The procedure was similar to that used to measure headroom except that the recording level control was used to keep the recorded level below 0 VU to avoid clipping in the record preamps. The input preamp overload levels were measured as follows.

ReVox	Mic (low)	16 mV
	Mic (high)	270 mV
	Aux	4 V
Braun	Mic	125 mV
	Aux	3 V
Teac	Mic	85 mV
	Aux	Unlimited

These overload levels are compatible with most consumer equipment. But if you use professional gear such as Shure mixers or a Type A Dolby, their high signal voltages may overload the auxiliary input of the ReVox or Braun. The Teac has its record volume control ahead of the input amplifier, making input overload impossible.

Sensitivity. Rather than using the conventional measurement procedure for sensitivity, I made recordings on each machine using a low-impedance mike, to obtain a practical assessment of each recorder's sensitivity. The mike was a Beyer 260, a ribbon microphone which retails for about \$100; it is a high quality mike which has a relatively low output level. The microphone input of the Braun recorder was not sensitive enough when I was recording a classical guitar. This lack of sensitivity of the Braun was verified by its owner; however it did perform satisfactorily with the Beyer 260 in close-up miking situations. The Braun should be used with relatively high-but-put microphones. Evidently its excellent microphone input overload figure was obtained at the sacrifice of mike preamp gain. The ReVox and Teac had adequate mike input sensitivity for my recording session, but the Teac was marginal; it too should be used with relatively high-output mikes unless they will be close to the sound source.

Tape transports. The fast-forward winding time for a 7" 1800-ft. reel of tape was clocked as follows: Braun 68 seconds, ReVox 83 seconds, Teac 95 seconds. Another feature which has received some attention recently by designers is how neatly a recorder can fast-wind tape. Uneven winding will result in tape damage, with increased dropouts. To test this the same two warp-free reels were fast-wound on each machine and inspected; each wound smoothly, with no obvious differences among the six recorders tested despite the differences in winding speed.

The Braun is the only one of these recorders capable of going directly from fast-wind into play. This feature of the Braun worked extremely well without any hint of additional tape tension. However, the Braun probably should not be used to "rock" tape to a standstill, particularly if half-mil tape is used. It has a tendency to jerk the tape violently if the fast-forward or rewind button is depressed while going full-speed in the opposite direction. The owner of the Braun had broken some of his older half-mil tapes by using the rocking procedure too liberally.

All three models stop so gently that it seems unlikely that the rocking procedure is really necessary. All were judged gentle to the tape, as estimated by placing a pencil or finger in the tape path and depressing the STOP button. The Teac had the fastest-stopping breaks with the Braun a close second. The advantage of the Teac system was that it stopped both reels simultaneously, while the Braun and ReVox allowed the take-up reel to coast to a stop.

The convenience of solenoid operation offered by these three decks is enough in my opinion to justify the additional cost of such machines over mechanically operated ones. Please remember, though, that solenoid operation does not add anything to the sound; it does offer another level of convenience and tape handling speed. After having lived with a solenoid operated tape recorder for almost a year, I will never go back to the mechanically operated type. During this series of tests I had some experience with the Tandberg 6000X; it is a fine tape recorder, but it felt mechanically clumsy to me. Contributing partially to this feeling of clumsiness is the additional head and pressure pads required for cross-field biasing. These added heads and pads also make the Tandberg more difficult to clean.

The Teac had an extra feature that I found useful. It was the only machine that completely shut down the capstan motor at the end of the tape or when the STOP button was depressed. This Teac feature of completely shutting-off the capstan motor is a good idea because it allows you to leave the recorder on for some time without worrying about burning out the capstan motor.

Both the Braun and the Teac had pause controls while the ReVox did not. But I do not feel that this is a serious lack in the ReVox since the machine does start up instantly.

Editing was judged to be easiest on the ReVox, which was the only machine that had a separate on/off switch for the reel motors and the ability to disengage the reel brake motors for easier threading, editing, etc.

Of the three tape recorders the Braun was the easiest to thread tape onto followed by the ReVox. The Teac was the most difficult to thread because of its additional arms or tape guides. With most tape recorders, you must use reel locks to hold the reels in place when the machine is used vertically. The three machines tested here all have locking mechanisms which hold the reels in place. The Braun's system was best; it engaged the reel with only a half-turn of the spindle, whereas the Teac required two or three turns to latch the reel in place. Both the ReVox and the Teac will accept reel sizes up to 10h and appropriate tape tension adjustments are provided. The Braun is limited to 8" diameter reels.

Only the Braun has two systems of disengaging the transport or putting it into the stop mode; it uses both a mechanical and a tin foil STOP arrangement. When the tape reaches the end of its travel, the ReVox, Braun, and Teac stop for different reasons. The light-sensitive system of the ReVox senses that there is no tape in the



transport and shuts off. The Teac and Braun have mechanical arms which swing inward to indicate that the tape has ended. In addition, the Braun can be rigged to stop at any point where metal foil is applied to the tape. This is especially convenient when using Maxell tape since it comes with the appropriate tin foil. In order to program the ReVox to stop, the tape must be spliced with clear leadertape, which is difficult to find in stores.

The Teac has a lever on its front panel to engage the fast-forward, rewind, play and record positions. It is inconvenient to use and prevents the Teac from being used with a remote control. The ReVox and Braun offer full remote-control facilities. Three remote-control units are available for the ReVox, ranging in price from \$30 to \$60. The \$30 model can be used with a timer to start and stop the tape recorder when you are away from home. The Braun offers the same convenience for about \$60.

Miscellaneous notes. The Revox and Braun both ran quietly. The Teac was noisier than the others but not objectionally so.

Only the ReVox and Teac tape recorders can mix line and microphone inputs and only the ReVox has switchable input selection facilities for each of its inputs. Before using the auxiliary input of the Teac, the microphone input level control must be turned to its minimum position or it will feed noise to the line. The two high level inputs of the Braun mix automatically so one set must be removed to obtain the lowest possible noise during recording.

All of the recorders had volume-controlled headphone output jacks. The Braun and Teac were judged adequate for home listening with Koss Pro-4aa phones, but inadequate for monitoring at live recording sessions. The output voltages corresponding to 0 VU measured as follows:

ReVoX	0.8 V
Teac	0.16 V
Braun	0.07 V

The record level meters of the Braun and ReVox appeared to have similar ballistic characteristics. The Teac's owner and I felt that its meters were insufficiently damped, making it difficult to set levels.

The Teac is the only recorder of the three to read both input and output level of the signal. The Braun and ReVox meters both read input level, but reading output on the Braun was impossible. With the ReVox, you must switch the input selector control to I-II for the left channel, and II-I for the right channel and mark the level corresponding on the meters to input signal level. Once that position is marked, the playback levels can be monitored. But Teac has the right idea.

Proper head alignment is necessary for good recordings. On both Brauns, however, the playback head was seriously out of alignment.

This is peculiar because one of the Braun was tested when it first arrived about three months earlier, and the alignment was correct. On the other hand, both the ReVox and Teac had maintained their alignment without readjustment over equal and longer periods of time.

The bias on all three tape recorders appeared to be a perfect sine wave, a feature which minimizes bias noise. The Teac has a bias switch on its front panel -- an excellent feature because it enables the user to interchange low-noise and standard tapes. All tape recorders should be so endowed. On the other hand, the Teac lacks a monophonic output -- a minor inconvenience.

The Braun is the only machine without an output volume control. I feel that this is a serious deficiency. The output signal level from the Braun was quite high, which makes this lack doubly irritating. With the other machines, one can set the output signal level to a point equal to that of other signals from other components in the system. The Braun does have an additional speed of 1 7/8 inches per second that is especially useful for non-high-fidelity recording applications.

The ReVox has the best warranty. Parts and labor are guaranteed for one year as with the Braun and Teac, but most ReVox parts are guaranteed for life. The life-time guarantee excludes heads, pressure rollers, and capstan.

Beauty is in the eye of the beholder, but the Braun looks and feels rugged. The ReVox with all of its plastic, looks less professional, and though they never seem to fail, its controls feel imprecise -- even so, they provide the greatest flexibility of the three recorders.

The ReVox is the only machine of the three which offers a carrying case as an option. Also, optional stereo amplifiers can be easily plugged into the PC board rack within the ReVox, giving its owner even greater flexibility.

Serviceability . In this category, the ReVox has no peer. The Revox service manual is over fifty pages long, costs \$10 and is an excellent investment and a delight to use. The ReVox also has its major amplifier boards, power supply module, etc., on PC boards which can easily be flipped out for servicing. The ReVox manual is detailed with pictures, drawings and full instructions for assembling and adjusting the machine. It identifies each of the user-adjustable controls, such as separate bias and equalization adjustments for each channel and speed. These adjustment points are also labeled inside the machine, and biasing and equalization can be accomplished without removing anything but the external shell of the ReVox.

The comparatively small Braun service manual costs \$3.50 and uses many terms unfamiliar to American readers. For example, bias adjustment is identified in the Braun manual as a "magnetism" adjustment. Removing the Braun's cover reveals no easily removable PC boards or easily recognizable bias adjustment controls. And the Braun offers no record equalization adjustments as does the ReVox, although bias is adjustable for each speed. Servicing is best left to a technician.

I did not have a service manual for the Teac, but after removing its shell, it seemed potentially as difficult to service as the Braun. A good service manual could alter that view.

Summary. In conclusion I should like to have a recorder with the Revox's

- unweighted signal to noise ratio,
- headroom,
- serviceability, and adjustable bias and equalization for each speed,
- output level control (and Teac's),
- control and input flexibility,
- input mixing capabilities,
- monophonic output (and Braun's),
- meter ballistics,
- 10-1/2 inch reel capacity (and Teac's),
- running quiet (and Braun's),
- headphone output level, and its
- carrying handle and optional carrying case.

From the Braun I should like its

- foil sensing shutoff,
- tape and reel loading ease,
- fast winding speed,
- ability to shift from fast wind directly into play,
- 1-7/8 inches per second extra speed, and its
- feel and looks.

And from the Teac, its

- infinite overload capability (on auxiliary input),
- bias switching,
- playback metering,
- brakes, and its
- automatically switched off capstan motor when not in use.