THE BAS SPEAKER

The Publication of the Boston Audio Society

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Volume 17 Number 4

The BAS Speaker (ISSN *0195*-0908) is published bimonthly by the Boston Audio Society. A subscription is included with membership in the Society. Membership dues in the US are $22 per year (corresponding with a volume of *The Speaker);* for rates outside the US, see application form. $20 of the US dues are for *The BAS Speaker,* including all issues of the applicable membership year. For information and application form, write to: The Boston Audio Society, P.O. Box 211, Boston, MA 02126-0002.

POSTMASTER: Please send address changes to: The BAS Speaker, P.O. Box 211, Boston, MA 02126-0002.

Open Forum

An Expensive Stereo System

Audio's directory issue (Oct) is getting very thick and is full of thick, glossy ads. Noting how expensive high end components are, I put together the snobbiest system:

Accuphase DP80L/DC81L CD player	$ 13,000
Nakamichi 1000 DAT	10,000
Nagra T-Audio open reel	22,450
Revox B215S cassette deck	2,800
Grundig Quintessence turntable	30,000
Goldmund T3F tonearm	4,750
Kiseki Lapis Lazuli cartridge	5,600
Sequerra Broadcast Monitor tuner	12,800
B&K 3529 microphones, 3 pieces	16,134
Yamaha DSP3000 surround processor	1,899
Cello Audio Palate equalizers, 3, surrounds & main channels	31,500
Jadis JP200 preamp	18,000
Maverick Ultimate Phono Processor	10,000
Silbersand FM40 power amp, 5	175,000
Stax Lambda Signature, 2	3,998
Wilson Audio WAMM main speaker (bi-amplified)	88,000
Wilson Audio WATT ambience speakers, 2 pairs	12,000
Total	$457,931

This does not include cable costs, which can easily be another $20,000. Add my 130dB/12Hz subwoofer and 4 more power amps to drive it and it will hit the three-quarter-million mark....

— *Poh Ser Hsu (Massachusetts)*

Allison AL-130 Review

The Allison AL line represents a departure from the Allison approach: it's designed for placement away from walls. Placing these speakers close to walls will produce cancellation dips.

The away-from-wall placement puts the listener closer to the speaker, i.e. more in the direct field, resulting in sharper imaging, and better resolution of detail.

The AL-130 is the top of the new line. Its dimensions are 38x13x14 inches, with two 8-inch woofers in push-pull (minimizing even-order harmonics), and Roy's midrange and tweeter (which, unlike those of the One, are protected by strong grilles). Crossover points are 450Hz and 4kHz (the same crossover as in the CD-9). Retail price is $1,100 a pair.

I auditioned them 4 feet out from the front wall, and 6 feet from the side walls in a 3,400 cubic foot room, with the Allison Ones for comparison. They sounded closer to the Allison Ones than any other Allison models I have auditioned, with a bit more detail. This added clarity, although appreciated on some music, made them sound more like speakers than music on others.

Allison has achieved uniform power response while retaining tight imaging. The AL-130 also has less bass distortion than the Ones, thanks to the push-pull design. They worked very well with the Allison subwoofer (an equalizer to extend the low frequency cut-off). My only reservation is the relatively high acoustic center of the woofer pair, resulting in some potential mid-bass/lower midrange dip. However, I did not detect any dip in my listening tests.

In conclusion, they are one of the best "freestanding" loudspeakers currently available, certainly a "best buy" at $1,100 a pair.

— *Howard Ferstler (Florida)*

CD Review

[Equipment used: Magnavox FD1010 CD player, Apt/Holman preamp, Apt One power amp, Allison CD-9 loudspeakers, Stax SR-X electrostatic headphones.]

Franz Schubert *Piano Trios* in B-flat, Op. 99 (D. 898), and E-flat, Op. 100 (D. 929); *Adagio* in E-flat, Op. Posth. 148 (D. 897); *Trio* in one movement in B-flat (D. 28). Beaux Arts Trio (Menahem Pressler, piano; Isidore Cohen, violin; Bernard Greenhouse, cello). Philips 412 620-2 [DDD]. 46:55, 51:09 (2 discs).

I fell in love with Schubert's trios 20 years ago, when I bought a copy of the Istomin/Stern/Rose trio's performance of Op. 100 (Columbia LP MS7419). It is interesting to compare not only the playing but also the recording style, because I grew up, so to speak, with the earlier recording and yet prefer the later.

One of the early Romantics, Schubert wrote lyrical themes and spun them out to extraordinary length, using subtle alterations of balance and color rather than Classical forms and developments. Uwe Kraemer, writing the notes for this recording, said Schubert's "musical imagination was stimulated not by motifs and structures but by harmony and sound." To make this work, his pieces must be played as if spontaneous and improvised.

This the Beaux Arts Trio accomplishes, and with the aid of their recording team the "group improvisation" effect is enhanced on these discs. I noticed right away that the stereo image is both diffuse and relatively narrow: the three musicians are closely spaced, and difficult to pinpoint. With my eyes closed, this seems perfectly natural, as it is the kind of image I have often heard from the balcony of Jordan Hall. By contrast, the Columbia recording is extremely wide, and the images are isolated from each other.

The paradoxical nature of the earlier recording is that, although each player is distinct, they are not well-balanced, and the interplay of violin, cello, and piano is hard to follow. Perhaps the sonic spacing is at fault; perhaps the three virtuosi really did not play together as well as the members of the Beaux Arts. This is not unprecedented: listen to any of the recordings made by Cortot, Thibaud, and Casals. Three strong ideas about

the music, instead of one shared idea, may be interesting, but it is not trio playing.

The Beaux Arts Trio also is more relaxed than Istomin/Stern/Rose. Here the melodies sing freely, the long lines breathe, the flow is unforced. I find myself pulled, rather than pushed, by the phrasing. I/S/R play the allegro moderato of Op. 100 in 13:09; Beaux Arts take 14:20, yet the intrinsic pulse does not sag; it simply seems natural.

Overall sound quality and balance are good: except for the less-than-pinpoint imaging (which might bother some listeners, but which I find to be a quite reasonable perspective), nothing about the recording drew my attention away from the playing. And the playing drew me into, rather than away from, the music. Although the timings are short for CDs, and I wish there were more, this still is a worthwhile set to have, because it is complete, and because it is a good example of unforced music-making.

Mark P. Fishman (Massachusetts)

Book Review

***Killer Car Stereo on a Budget,* Daniel L. Ferguson, Audio Amateur Press, Peterborough, NH**

This is a well-written book for amateurs on how to upgrade car stereos. It is for people who do not have much technical knowledge but are handy.

It suggests that the biggest improvement is achieved by changing the speakers. It then goes on to give specific suggestions for several types of vehicles: sedans (chapter 2), hatchbacks (chapter 3), and trucks (chapter 4). Detailed baffle-cutout designs and enclosures for specific drivers are provided. Chapter 5 covers cabinet construction, while chapter 6 shows how to build an electronic crossover. Chapter 7, perhaps the most useful chapter, gives advice on installation.

Unfortunately, no charts or formulae are given to calculate enclosures for user-selected or future drivers. Luckily, other publications are available from Old Colony (related to Audio Amateur Press) or Radio Shack for the more adventurous who want to design an enclosure for other drivers.

In summary, this book is a good starting point for someone not too technically oriented who wants a good car stereo at a bargain price.

— *Poh Ser Hsu (Massachusetts)*

Speaker Testing

Stereo Review's loudspeaker tests leave a lot to be desired. A curve is worth a thousand words, and *Stereo Review* has chosen to use a few words instead of curves for speaker measurements. For example, distortion is normally given for several points, usually different for each review, making it difficult if not impossible to compare products.

Reviewer Julian Hirsch recently obtained misleading results when close miking the Allison AL-120. He should have discussed measurement problems with Allison to straighten out the issue instead of publishing the flawed measurements. (He assumed, among other things, that the two push-pull woofers covered the same frequency range.)

In contrast, the review of the Allison AL-125 by David Moran in the Sept *CD Review* gave lots of curves, with guidelines on how to interpret them. This and other speaker reviews by Moran have the most comprehensive set of frequency response curves in any publication to date. Moran should be congratulated. However, he does not do bass distortion measurements. I hope *CD Review* will add this.

Subjective reviews, although not as informative as those by Moran, can be both educational and entertaining if the readers bear in mind the effects of the reviewer's room, placements, source materials, and taste.

— *Howard Ferstler (Florida)*

February 1989 BAS Meeting

Open Forum

BAS finances are good; we are about $1,500 in the black because of economies in the production of the *Speaker.* We are currently stable at 300-325 members, and could still function economically with 250 to 280 members. This is the first time in several years that we have been in the black. Our rates have held stable at $22 for three years and will stay at that level for the next volume of the *Speaker.* There was a proposal to use some of our balance to increase payment for meeting summaries from $100 to $125 and also to pay modest honoraria and to provide some payment for the editor. After discussion the present system was left unchanged.

Frank Farlow noted that there is a constitutional provision that all five offices and the editor get a token $100/yr for their services, which may require about the same time per *month* as the estimated 10-20 hours to prepare a meeting summary.

President David Moran commented that writing was hard work and fundamentally different from editing or volunteer work and that we were not paying for the value received. Essentially, he pointed out that we would be using the money that has been saved in *Speaker* production. The outgoing editor, Mark Fishman, disagreed, citing the society's recently precarious fiscal position and the fact that we are, after all, a volunteer group. Ira Leonard, the treasurer, also noted that our finances have been shaky and that they are just starting to stabilize.

There was also a proposal to pay the bus (or even plane) fare of some guest speakers. This was not pursued.

Finally, elections will be held in March. Fishman, who has been editing the *Speaker,* announced that five years is enough for him, so we have a new editor, Poh Ser Hsu.

One member showed a CD made in West Germany by PDO that, when viewed using a strong light, had a somewhat transparent coating and there were multiple starburst effects from pinholes where there was no aluminum coating. This plant presses for all of the Polygram group (London, Philips, DG). However, although the coating is certainly thin, the CD played in a Technics CD player without problem, so it is not clear what effect the less dense coating has. David Moran commented that many of his CDs have the star burst effect and that he had not noted any relation to label or pressing source.

Other members noted that tracking of defective CDs seemed to depend on the particular player. Moran commented that tracking ability depended on how the pertinent trims of the player were set up when the unit was made, and that trims often were not well-adjusted at the factory.

More CES News

There is a new Monster cable for biwiring (using a single amplifier but running separate cable pairs to the tweeter crossover and the woofer crossover). In connecting a single amp to the two halves of the crossover with separate wires, the intention is to reduce interactions between the two halves of the crossover. This new cable uses two pairs of wire in a single cable assembly. There are two different sizes of wire in the cable, with the small wires along the outside edges, the larger pair in between, and a large non-conductive space in the middle. The stranding in the pairs also goes in the opposite directions. This cable is also flat, which makes it easier to lay.

Micha Schattner commented that having the stranding anti-parallel helps RFI rejection. RFI could be a problem as the speaker wire is unshielded and goes directly into the feedback loop of the amplifier.

There are also RCA plugs that allow piggybacking. They had the normal 2 male connectors separated by 6 feet of cable, but the back of one of the plugs had a socket. This could eliminate the use of Y connectors. However, Micha noted that you should look at the input and output impedances in this kind of setup, to be sure you are not loading down the source.

Al Foster reported that a local newspaper had an article on Acoustic Research. Their speakers are not carried by Lechmere anymore, which accounted for a million dollars a year. AR acted much like a university, with many speaker designers starting there, but now seems to lack direction. However, AR may start making drivers in Canton again. They aim to go back to the original 12", 10", 8", and 6" woofers by late summer (July–August). One of the surprising things is that Japan is buying AR 3as. These will still have a 3/4-inch tweeter and 3/4-inch wood cabinets. But now they are buying (and modifying) the 12-inch woofers. AR's new speaker designer John Buzzotta was previously with dbx, Advent, Peerless, Kloss, and von Recklinghausen before that.

Micha Schattner commented that he heard the Celestion DL3 at CES. They retail at $250/pr and sound better than most mini-monitors, having an open midrange. They use a 6" rather than the usual 8" woofer.

John F. Allen, who develops and installs theater sound systems, reported that Fred James has developed a correlator that samples two channels and locks them together. This allows the analog and digital sound tracks of a movie to be synchronized. He commented that "it does work from time to time."

There is a new Sony 18-bit CD player with 4x oversampling, audibly different from their 16-bit 1x system.

David Moran will be writing for *CD Review* (formerly *Digital Audio).* New technical editor Daniel Kumin should be able to get rid of the errors that have occasionally appeared in that publication. Moran will do speaker reviews and features.

In his comments on high-end audio Moran reported that J. Gordon Holt of *Stereophile* had found THE BEST preamp, costing $7,000. It reported had a noise spec of 80dB A-weighted below 1 volt or 74dB unweighted. This was for line level, not the phono input, and is 20dB noisier than an NAD or dbx preamp. It also has no balance control, using instead 2 volume pots with a 2dB resolution, which should destroy imaging. The unit also allows you to set up the tape loops so that it will oscillate.

John S. Allen reported that the noise levels on the Channel 44 digital broadcasts are set by the mike preamp. Each bit equals 6dB, so you can tell what the S/N is by looking at the bitstream on the television. He has never seen any program that goes below 60dB. [This was a reference to the digital audio transmission experiment which WGBH-FM conducts in Boston, using the frequency of their UHF-TV affiliate WGBX.]

Ira Leonard reminded us that one proposed Massachusetts budget slashed the funds available for the arts. For example, the Massachusetts Council for Arts gets no funding (as in $0) in one of the proposed budgets, so we can take our place among the truly backward states.

Meeting Feature: A Magnetostrictive Loudspeaker from M. B. Quart

M. B. Quart, like Magnat, is a West German speaker company. They are trying to sell speakers based on looks, technological appeal, and technology.

Bill McGrane is the local representative for M. B. Quart; he has been in this field for 26 years. They incorporated in the U.S. in July 1987; the office is in Walpole, Massachusetts. They have been making OEM drivers for a long time; for example, they make a good titanium-dome driver. The M. B. stands for "microphone engineering." They made headphones for Stanton, B&O, and

Tandberg. They have two factories of 15,000 square feet near Heidelberg and a third near Mossbach.

Dr. Siegfried Klein developed the magnetostrictive driver. He has worked for the French Atomic Energy Commission on plasma physics. (Shades of Dr. Alan Hill and the Plasmatronics driver.) The first speaker system to use Dr. Klein's spherical tweeter design is an M. B. Quart powered loudspeaker, a 2 cubic foot sealed-box system with a 10-inch woofer, a 2-inch aluminum dome midrange, and Dr. Klein's tweeter. The system is tri-amplified, with a total of 280 watts per channel: 140W for the woofer and 70W each for the midrange and the tweeter. Crossover frequencies are 500Hz and 3.5kHz. The cabinet is constructed of 7/8-inch 5-layer plywood. It is painted with 10 layers of lacquer and has a beautiful finish. The sample at the presentation had a large, clear plastic baffle which was probably just cosmetic. The speakers will sell for $25,000, with delivery in 90 days.

Operating Principles

Magnetostriction was first described over a hundred years ago by the English physicist James P. Joule. Magnetostriction is the rearrangement of molecules in a magnetic field. If a 1-meter rod of the proper nickel alloy is wrapped with wire and a DC signal passed through the wire, the length of the rod will change. This change is extremely small; e.g., for a magnetic field of 200-250 gauss the total change of a 1-meter rod might be 0.04mm.

However, if a thin spherical shell is used, and the magnetic-field change is uniform over the whole surface, the small linear change will result in a change in the diameter of the sphere, i.e., the sphere will pulsate as the field is modulated. [Note that if the magnetic field is non-uniform over the surface, the sphere will distort in shape, the surface in the stronger field shrinking more than the rest, i.e., it no longer behaves as a pulsating sphere—Ed.] It can move a significant amount of air if the sphere is sufficiently large.

The high-frequency unit in this first design is two half spheres of nickel with 4% cobalt. This was thin, dull, dark-colored, and a little flexible. It has a 10cm diameter, giving a surface area of 314 sq cm, which is about 60 times that of a 1-inch dome tweeter. The required displacement is thus 1/60th that of the 1-inch dome [Peak displacement required for the same SPL is inversely proportional to the radiating area—Ed.]

Magnetostriction always makes the material smaller. The rod in the example above would always get shorter, regardless of the polarity of the magnetic-field applied. This means that there has to be a static bias field to make sure that the speaker always works in its linear range. The effect of magnetic-field polarity reversal is similar to full-wave rectification of an ac electrical signal. In this design, the bias is supplied by a permanent magnet mounted inside the alloy shell. This ensures that the driver is in the *middle* of its magnetostrictive range with no signal applied, so that it can become both larger and smaller around that point.

The sphere is made by an electrolytic process, which is hard to do—especially in mass production. The modulation coil (this speaker's equivalent to the voice coil) is external and made of a single winding of flattened wire that has been crimped essentially into a wavy line. This is then wound over the surface of the sphere. Inside the modulation coil is the diaphragm, which is also spherical, and inside that is the permanent magnet which biases the driver by providing a fairly uniform magnetic-field of 250 to 300 gauss. [Unless the coil is held extremely rigidly, and damped, it too might radiate sound: it is, after all, a coil immersed in a magnetic field, just like a normal voice coil—Ed.]

Performance of the Tweeter

Dr. Klein claimed a very wide frequency range of 200Hz to 300kHz (±1.25dB from 3kHz to over 20kHz) for his driver; however, it is not used down to the bass for reasons of efficiency [and maximum output as well: assuming 0.04mm/meter change at 200-250 gauss modulation, max SPL at 1-meter with this. modulation level is 59dB at 200Hz in half space, 97dB at 1kHz, and 109dB at 3.5kHz, equivalent to a 1-inch dome with a 0.1mm peak excursion—Ed.].

The tweeter is crossed over at 3.5kHz, and was hard to aurally dissect out and ignore the contribution of the rest of the spectrum. Using this high a crossover decreases both the effect of the driver and the load it has to carry. The conventional part of the system did not seem to have the same clarity as the novel tweeter.

Dr. Klein also claimed 360-degree dispersion. He felt that omnidirectional speakers are closer to real sound because musical instruments, such as the violin, radiate in all directions.

[Because of the language difficulties—Dr. Klein has a marked accent in English—I could not tell if he meant that the speaker should attempt to mimic the radiation pattern of the instrument playing, which I do not think would be either possible (musical instruments radiate differently from each other) or useful, or that he meant that the omni pattern increases high frequency room reflections and contributes to the sense of "air." This latter idea is a valid approach—CD]

In any event, the speaker does radiate in all directions but I thought there was a level change behind it. I felt that there was good dispersion, without lobbing, over a 45-degree cone forward, and fair dispersion over the forward 90 degrees. The room acoustics interacted with the sound to create differences with time and spatial location, which makes the sound seem more lifelike.

[I do not think that this speaker is a viable commercial product—it simply costs too much for its overall sound quality. (Perhaps for any speaker?) The tweeter is the only major advance claimed. I think this was just a marketing vehicle to show off the tweeter. Given that, I was less concerned with the lack of bass extension that I would have been. The point of this speaker is the tweeter, and I think that you should listen to it on that basis. If you are interested in speakers you should listen

to these with the same interest in a new type of technology that you first listened to dome tweeters, electrostatics and ribbon tweeters, the Heil tweeters, or to piezoelectric tweeters—CD]

MBQ brought along a simple demonstrator. The magnet was fastened to the bottom plate, with the driving coil of wire wound above it. We could hold the hemispherical radiator, which had no attached wires, and slowly move it into the field. As the radiating element moved into the magnetic field the sound became louder and the level of higher-frequency distortion increased. Of course, in this demonstration, there was no termination to the edge of the hemisphere, and the hand holding the hemisphere would distort its shape.

This is a robust system: with all the handling and dropping, the dome was undamaged. Certainly most other high-frequency drivers are much less robust physically.

The sensitivity is a little less than a normal speaker's. The actual sensitivity for the same surface area is 10 to 12dB lower, but there is a larger radiating surface and the sound-power measurement is integrated over the whole sphere. This speaker uses an internal amplifier, so equalization or apparent sensitivity was just a matter of increasing gain.

As an analogy, Dr. Klein said that a concert piano can play very loudly because the entire surface is vibrating. He claimed that the low total distance moved resulted in low distortion.

This is a difficult technology and not just a rework of the dome tweeter. It is not limited by the applied voltage like an electrostatic [not in terms of arcing, but voltage drive is limited to that required to modulate the magnetic field by 250-300 gauss, beyond which the driver becomes extremely non-linear—Ed.]. Perhaps the closest equivalent is the Pioneer piezoelectric plastic-film tweeters of the 1970s [which do not suffer from the new design's bias requirements and its associated overdrive distortion problems—Ed.].

The speaker was designed for use in a live room. The bass is supposedly flat to 28Hz, but this seemed optimistic.

I found it very hard to focus exclusively from 3.5kHz up, which is where the sphere is working. The bass was tight and not muddy but it was not as deep as I would have liked. Again, this made it hard to tell just how good the sphere is, but is probably irrelevant to their production version.

Micha thought that the bass was muddy and that there was a lack of dispersion, probably from the dome midrange. He thought the top seemed reasonable and characterized the speaker as the beef flavor without the beef.

Ira Leonard liked the speaker but thought the bottom was congested. Some characterized the top as hot but I do not think that anybody complained of distortion.

The prototype shown to us is not the finished MBQ product (except for the elegant cabinet work), since so much of it was hand-assembled, and a little tuning may change the sound radically. Also, it is very hard to just listen above 3.5kHz and not let the bass or midrange influence your judgment. Certainly at this price point, the bass/midrange needs work to be brought up to the quality of the magnetostrictive tweeter.

Future Products

M. B. Quart have made similar magnetostriction spheres of 20-, 30-, and 40cm diameter, which they have used down to 700Hz. They also brought a picture of a 50cm sphere that they had made. The 50cm version can allegedly be used to 16Hz. [assuming a dimension change of 0.04mm/meter, the peak-volume change under 200-250 gauss change for the 50cm sphere is about half a cubic inch, equivalent to a 5-inch woofer with a 1mm peak excursion—about 59dB at 1 meter at 16Hz, and 91dB at 100Hz—Ed.] In the future, they hope that they will be able to use a single sphere for the entire frequency range in a commercial product.

I think that this is a very interesting technology and certainly worth listening to. We are very grateful to MBQ, Bill McGrane and to Dr. Klein for bringing this technology to market and for showing it to the BAS at this stage.

— *Carl Deneke (Massachusetts)*

June 1989
AES Boston Section Meeting

Spring Banquet and Elections

The June 13th meeting of the Boston AES section combined the spring banquet and election of officers. The guest speaker for the evening was William Busiek, longtime engineer for the Boston Symphony Orchestra's radio broadcasts and an important figure in the history of the Eastern-Public Radio network.

Bill Busiek joined WGBH-FM in October of 1951 and took over the Symphony Hall broadcasting booth the next fall. It really is his booth now, for besides bearing the stamp of his tenure, it also bears his name since its renovation a few years ago.

Section Chairman Joel Cohen and former Section Chairman John Allen both told us that it was Bill's dedication to excellence in radio sound that "hooked" them into the audio business. The quality of the live BSO transmissions, Victor Campos's tapes on "Adventures in Sound," and many other programs pioneered by Bill "still rival the best CDs," said John.

This was Bill's "maiden speech," he told us, because "since I heard my voice in 1948 on a Magnecord tape recorder, I decided not to inflict it on anyone." (Many are far worse, Bill, and you have much to tell.) But he wanted us to know that he, too, had been hooked by live radio in Boston: the house band at WBZ, Francis Cronin playing the organ from the Aeolian-Skinner Company,

and E. Power Biggs live on Sundays from the Busch-Reisinger Museum, at Harvard.

His electronics background came as a radio officer in the Merchant Marine, and it was a logical step to a broadcasting career. With the postwar blossoming of FM, he upgraded his radio-telegraph license to a radio-telephone license and joined the fledgling WBSM, in New Bedford. "They weren't on the air yet, and helping to start up the station, I learned a lot."

For one thing, every show was done live. Both the FM and AM transmitters (behind glass) were in the same room with the turntables, and in addition to cueing up records (were they LPs, 78s, vertical-cut, 16" transcriptions; did they run inside-out or outside-in; which arm had the right cartridge?), the engineers kept the program log and the transmitter log. Most of the programming was simulcast AM/FM, "but twice a day we did split programming, and there'd be one engineer for two announcers. We also answered the phone at night, and we did this 6 days a week, 8 hours a day."

When they did live remotes, they used an RCA OP7 mixer with an OP6 power supply. "It was all-tube, and very heavy. But if someone kicked the plug out of the wall, we had two minutes to plug it back in before we lost power from the supply."

On October 6, 1951, the Lowell Institute Cooperative Broadcasting Council made their first broadcast of a Saturday evening Boston Symphony Orchestra concert, over WGBH-FM. "I remember they played Tchaikovsky's Sixth Symphony, and at intermission there was just crowd noise. At the end of the concert, the signal just faded away, with no signoff. That got me, and two weeks later I was at WGBH."

The original WGBH transmitter was in the basement of the weather observatory on Great Blue Hill (hence the station ID). The antenna was on a telephone pole. Because there was a mile of dirt road up to the observatory, when there was ice in the winter, staffers would walk up the hill.

During the '50s, WGBH was affiliated with the Continental FM Network, paid for by Major Armstrong. The network carried live concerts from Washington DC, including chamber music from the Library of Congress. Within hours of Armstrong's suicide, however, the network broadcasts were ended. Armstrong's widow needed every penny to continue (and win) the patent lawsuits against RCA that had driven the Major to end his life.

It is interesting to note that the original studio-to-transmitter link, using REL equipment, achieved a signal-to-noise ratio of 72dB. REL was Major Armstrong's company, and was the standard for quality and reliability in FM radio equipment.

The microphone for the BSO broadcasts was a WE 640AA condenser lent to WGBH by Bell Laboratories. This microphone had a 90kHz top end, although it was starting to roll off around 15kHz. (It had been used to measure bat sonar in the range from 25kHz to 85kHz.)

WGBH did most of their programming either live or from tape, and didn't even have a record library until the mid-'60s. "We didn't need it: we offered something different."

Contrary to myth, Bill was not the first engineer of the BSO broadcasts (since he didn't even arrive at the station until two weeks after they started!). But he did take over after only one year, in 1952. He used the simplest possible hookup: one mike, bypassing everything except the preamp and level control, with the booth patched directly into the transmitter link. At the beginning no one was allowed to record the concerts in the booth (although many recordings were made off the air). The Symphony feared that taped concerts would get out and affect ticket and record sales.

There were several live trans-Atlantic broadcasts via the undersea telephone cable. "We had to use three cables, and split the frequency band so that we could get a 6kHz total bandwidth, then add them back together at the other end." Broadcasts were done to England and to France (when Pierre Monteux was conducting). For the French broadcast, William Pierce had to share the announcer's booth with the French announcer, "who wouldn't stop talking."

For several years, Martin Bookspan also announced for the BSO, because WQXR in New York took a separate feed of the concerts and wanted their own announcer.

WGBH added a television operation in the mid-'50s, also moving to 84 Massachusetts Avenue in Cambridge (until this time, the station offices were in Symphony Hall). It was around then that the Boston Arts Festival held in the Public Gardens arranged for the Boston Pops Orchestra to play Handel's *Water Music* while riding in swan boats! Bill was doing the sound, using an RCA 77D ribbon microphone from the station and a low-frequency AM transmitter supplied by CBS.

Everything had been checked out separately beforehand, but when plugged together at the scene there was tremendous hum. Needless to say, the CBS equipment used pin 2 for ground and 1 and 3 for audio, while the mike was wired oppositely. The helpful volunteer who held parts while Bill hastily soldered new connections was Daniel von Recklinghausen!

On WGBH's 10th anniversary, the staff went out for dinner to celebrate. The very next morning, there was no station it had burned to the ground. Bill went straight to Symphony Hall, set up a turntable, and the radio station was back on the air from the booth in Symphony Hall the same day. Channel 2 (TV) did not broadcast weekends then, and by Monday they had found temporary quarters, but the staff was dispersed all over Boston for a few years. WGBH moved into their present home, at 125 Western Avenue, in the mid-'60s.

Among the many notable developments that Bill helped start over the years was the National Educational Radio Network (ultimately National Public Radio), funded originally by a Ford Foundation grant. This involved two phone lines linking Boston, New York,

Philadelphia and Washington, running all the way south and then back north in a giant loop. Anything carried on the south-going line could be added to, and what came back north went out on the air at each station.

The human problem with this was that, for Boston studio personnel, there was a noticeable and distracting delay between whatever announcers said and when they heard their voices in their headsets coming back on the northbound wire. David Crocker built a voice-activated relay to mute the headsets whenever someone spoke (to avoid the echo), but it made in-studio conversations impossible. No one else with a headset could hear the speaker either.

TV studios were not very reverberant. In fact, they were so dead that Busiek arranged to use Symphony Hall and Jordan Hall as reverberation chambers. (Nowadays, they use Lexicon digital-reverb units.)

The joint effort between WCRB-FM and WGBH-FM got underway when they agreed to broadcast Boston Symphony concerts in stereo, each station carrying one channel of the signal. WBUR and WBCN were also doing this, as this was before FCC approval of the subcarrier system for stereo FM. It is interesting to note that WCRB and WGBH repeated this trick when experimenting with quad broadcasts around 1970. WCRB-FM carried the front channels, WGBH the rear, and two stereo systems were required to receive the broadcasts! (These were capable of sounding wonderful—pub.)

WGBH and Bill have been responsible for many firsts over the years: a digital broadcast of the *St. Matthew Passion* from Symphony Hall, carried over PBS on a TV channel in digital form; digital trans-Atlantic broadcasts; and more recently the digital radio transmission experiment (bringing regular programming to the home in digital form) conducted with the assistance of WGBX-TV, WGBH's UHF affiliate.

It is our hope that there will be many more firsts in Bill's future. The legacy he has built ensures that there will be many years of enjoyment for those of us who listen.

Mark P. Fishman (Massachusetts)