

Interview with Earl Harford

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Earl Harford

Editor's note: Recently, the world of audiology and acoustics has seen the passing of three founders in the field: Earl Harford, Bill Rintelmann, and Leo Beranek. In recognition of their accomplishments, we invite you to read the interview below that Marshall Chasin did with Earl Harford a few years ago and we encourage you to visit our "[Happenings](#)" section for more detailed obituaries for all three.

Marshall Chasin (MC): When you hear the name Earl Harford one normally thinks of CROS hearing aids. Specifically, Harford and Berry (1965) in the *Journal of Speech and Hearing Disorders* was the article when I first read about your work with what to become known as the CROS hearing aid. What led you to do work in this area?

Earl Harford (EH): I worked in an audiology/otolaryngology clinic that we held once a week at Northwestern University in Chicago and there was an otolaryngologist that I worked with named George Shambaugh, a distinguished otolaryngologist and a long-time editor of the *Archives of Otolaryngology*.

One day we had a patient come in with a unilateral hearing loss. We counseled him in the routine manner for at that time there was nothing that could be done in a medical or surgical manner and from the standpoint of using a hearing aid he was not a candidate because his good ear was too good and his bad ear was too bad to make any sense of amplified sound.

We told him he can compensate for this to some degree by ensuring that his good ear is aimed towards the speaker and to seat where he would always favor his good ear – we discharged the patient in the usual manner. Then Dr. Shambaugh turned to me and asked whether I had ever considered putting a microphone on the bad ear and running a polyethylene tube around and sticking it in the good ear. That would carry the sound across the head. I hadn't really thought too much about that since there would be too much loss of the higher frequencies due to the presence of this long tube.

I went back to Evanston, Illinois (these clinics were always held in the medical school in Chicago) and I told Joe Barry, my grad assistant, about this and we both laughed and thought that this idea would not work. After a few days of thinking about it, it occurred to me that we don't have to use a tube – we could use a wire.

Perhaps I could get a couple of hearing aid companies to make such a device for me and we could do a little study on it. I had access to Zenith, Maico, and Beltone at that time – Zenith and Beltone were housed in factories in and around Chicago at that time and it made it easy, and I had a good working relationship with Maico as well.

We tested quite a few people and it turned out that it really worked quite well. In the Harford and Berry (1965) paper we emphasized that the best success was when a person had a high frequency hearing loss in the good ear. Many people forget this and the greater the high frequency hearing loss that a person would have in their good ear, the more difficulty a person would have in compensating for their unilateral hearing loss. Consequently the experience of greater benefit and also greater acceptance of the device was seen with those who also had a high frequency hearing loss in their good ear.

Another thing that we pointed out in the 1965 article was that the more recent the hearing loss in the bad ear, the more acceptance we had with the CROS aids. Conversely if a person is congenitally deaf on one side, he becomes so adjusted to that, he won't appreciate much improvement from the CROS aid. Still we had some people (even some with congenital losses) who accepted the CROS and used it on a regular basis.

CROS hearing aids are still being used. Soon, we branched off from the original CROS and did a lot of work with different devices that sought to address the issue of imbalance between the two ears. These included a multitude of names and acronyms such as BICROS, HI-CROS and the power CROS Versions of the CROS Hearing Aid. The power CROS is really the same thing that Roy Sullivan referred to as the transcranial CROS.

Jim Curran (who was then with Maico and later with Starkey) used to tell a romantic story of one of the first CROS aids that went from side to side with a black headband – I believe that he was a lawyer. After using it in court, the lawyer refused to give it up. We had some people that when we took the prototypes back from them they were really concerned and didn't want to give them up.

Elizabeth Dodds was a speech pathology student and after taking my clinical audiology course, she switched over to audiology. I then hired her as a clinical supervisor when she graduated. She was a ballerina before she went into audiology, so this being her "second career" meant that we were of a comparable age. In 1968 Elizabeth and I published an article in the *Journal of Speech and Hearing Research* entitled "Modified Earpieces and CROS for High Frequency Hearing Loss,"

At the time we were not aware, but it ultimately stimulated some people to think about open ear canal fittings. We followed that up in 1970 with "Followup-Report on Modified Earpieces and CROS for High Frequency Hearing Loss," (Elizabeth Dodds and Earl Harford, 1970, JSHR, Vol.13, #1, 41-43).

We still didn't realize what an impact that would have on open canal fittings. Jim Curran has pointed this out to me several times and from that time on I always vented as much as I could except under extreme circumstances with very severe losses.

I remember when I had students at the University of Minnesota I told them step #1 was use binaural whenever possible; step #2 is to cut the lower frequencies; step #3 was vent as much as you can; and step #4 use in-the-ear fittings because you were taking advantage of the auricle and the various structures of the pinna to amplify high frequency sounds prior to reaching the actual hearing aid. And to this day I would not change those basic four rules. I wear in-the-ear hearing aids to this very day and favour them over behind the ear hearing aids whenever possible.

I received my master's from Vanderbilt and then went to Northwestern University in Chicago for my PhD in 1955. There were three faculty member there – Ray Carhart, Jim Jerger, and John Gaeth. John Gaeth later went to Wayne State.

After I completed my PhD studies, I moved to Montreal, Quebec and joined the faculty at McGill University and established the Audiology Clinic at the Royal Victoria Hospital in 1958. After about a year in Canada, I was invited back to the faculty at Northwestern and apparently to fill John Gaeth's vacancy. I was a faculty colleague of Raymond Carhart for over 16 year. Jim Jerger stayed until 1961 then left for the VA in Washington, DC, and then down to the Baylor College of Medicine in Texas where he spent many years.

Tom Tillman was the next to come on to the faculty and then Bill Rintelmann and also Bill Carver came through the post-doctorate program there. Bill Rintelmann and Wayne Olsen both ultimately joined the faculty at Northwestern. Noel Matkin came from the University of Connecticut – we had a great faculty there for many years.

MC: After moving from Northwestern I understand that you moved to Vanderbilt and later to the University of Minnesota. You had some famous students at that time.

EH: Yes. Over the years I had some super students who ultimately contributed greatly to the field – Jay Hall, Bob Johnson, Deborah Hayes, Wayne Olsen, and Brad Stach to name just a few.

MC: Let's switch over to the fact that many people call you "Dr. Real Ear Measurement." I guess that we can't really talk about real ear measurement unless we mention the name of David Preves in the same breath.

EH: I started to work on real ear measurement in 1975 which was my last full year at Northwestern University. I went to Vanderbilt on January 1, 1976 but my last few months at Northwestern David Preves and I got together and talked about Knowles new, tiny (at the time)

microphones being placed in the ear canal. I don't know how it all began but it was David or myself that thought about putting the actual microphone in the ear canal. Later, Starkey called this the RE-4 and was marketed in the mid to late 1980s as a probe microphone (and not a probe tube microphone).

MC: I recall that up to 3000 Hz the RE-4 was actually quite good but above that (due to the physical volume of the microphone itself and the fact that it could turn sideways in the ear canal) the higher frequencies were suspect.

EH: It was pretty crude – the microphones were large and we had to use rather crude equipment. When I left Northwestern, I went to Vanderbilt and became an administrator. I became the director of the Bill Wilkinson Hearing and Speech Center and Head of the Division of Hearing and Speech Sciences so I was a busy guy pushing papers and solving people-problems. I didn't do any research while at Vanderbilt but I did write some articles while I was there. One was with Jennifer Fox called "The Use of High-Pass Amplification for Broad-Frequency Sensorineural Hearing Loss," where we emphasized the importance of cutting the lower frequencies for people with at sensorineural hearing loss.

I ultimately married Jennifer Fox and she and I have been married for 35 years. Actually Jennifer followed a similar path as Elizabeth Dodds and she eventually became my graduate assistant but I never really got to know her until about 7 years after she left the program. I see her every day now and we only talk about the benefits of high pass amplification... (just joking, we also talk about other things).

Then when I went to Minnesota I was 10-15 minutes away from David Preves at Starkey and we had a regular pipeline of these miniature microphones. We were ruining the microphones every couple of days and at first we didn't understand it. It turned out that there was a build-up of an electro-static charge on them by walking across a carpeted floor in the sound rooms.

I ran over 8000 measurements in the Medical School Audiology Clinic because we had a lot of patients there. The equipment was working very well and we were able to collect a lot of data – I felt like Jim Jerger! If you had your protocol set up correctly you could gather a lot of data.

The first article that actually appeared in *Ear and Hearing* in 1980 but the first paper I wrote wasn't actually published until several years later in the proceedings of a University of Minnesota conference on sensorineural hearing loss, tinnitus and vertigo held in September 1979.

The most inspiring thing happened after my presentation. Dr Hallowell Davis attended the symposium delete and told me that I was on the right track and we should have been looking at this many years ago. He was the senior author of the first text book of audiology (Hearing and Deafness, A Guide for Laymen) that I had studied back when I was 20 years old. I'll never forget his words of encouragement.

MC: I understand that other than being Dr. CROS and Dr. Real Ear Measurement, you were also known as Dr. Tympanometry?

EH: I did some early work on tympanometry with Gunnar Liden from Sweden. He and I were very close colleagues and we had spent some sabbaticals together.

When I was at Northwestern he came over and spent 15 months and he brought with him the notion of tympanometry from Sweden (based on the work of Henry Anderson and Klockoff at the Karolinska Institute of Technology [KTH]).

To digress, we used to ski together and one day we were discussing what other work we could do together so that he could have a reason come back to the States to work (and ski). On a chair lift in Utah we discussed the BAHA that he was doing some work with Anders Tjellstrom at the

University of Gothenburg and we thought that we would develop this. Ultimately he spent two years at the University of Minnesota where we did early research on BAHA (1983–1985).

To come back to tympanometry in the mid 1960s at Northwestern we had to use two bottles of water mounted on a wall rack and we would move them up and down for high pressure and low pressure while a tube was connected to a subject's ear canal. Electronic manometers were not available to us. We never did actually publish an article on that unfortunately. We were preoccupied on trying to get the apparatus to work, but we did run some very early tympanograms.

Audiology was so romantic back then delete. I never remembered a day I resented going to work. In the early years we had to do everything by hand. For example, my first 80–90 publications were done without a computer they all had to be done on a typewriter with no errors and had to be submitted with carbon copies.

I took my first course in audiology at Florida State University in 1950 and never looked back. I was about 20 years old then. I've been in audiology for about 62 years now and I've seen a lot of changes. It's been a whole lot of fun.

MC: It's been a pleasure talking to you. Thank you for your contributions to the field.

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