

## The Hearing Aids of Yesteryear

Published March 12th, 2015

Neil Bauman, PhD

### Introduction



Hearing loss has been around since ancient times. So have hearing aids. Unfortunately, the origins and the designs of those early hearing aids have largely been lost in the mists of time. However, as Europe emerged from the darkness of the middle ages into the light of the Renaissance and Industrial Revolution, there was also an awakening interest in helping hard of hearing people hear better. It was at this point that people began to develop “modern” hearing aids.

The first written mention of a device for hard of hearing people is in *Sylva Sylvarum: A Natural History*, by Francis Bacon, published in 1627. In Paragraph 285 Bacon proposes what we would call an ear trumpet. He writes:

*"Let it be tried, for the help of hearing, (and I conceive it likely to succeed,) to make an instrument like a tunnel; the narrow part whereof may be the bigness of the hole of the ear; and the broader end much larger, like a bell at the skirts; and the length half a foot or more. And let the narrow end of it be set close to the ear: and mark whether any sound, abroad in the open air, will not be heard distinctly from further distance than without that instrument."*

Bacon continues,

*"And I have heard there is in Spain an instrument in use to be set to the ear, that helpeth somewhat those that are thick of hearing."*

From this we learn that early ear trumpets were already being used at this time in Spain. Surprisingly, bone conduction hearing aids developed in parallel with air conduction aids such as ear trumpets and conversation tubes. For example, one of the earliest “modern” hearing aids was simply holding a spear or rod in your teeth and touching the butt end to something solid and hearing via bone conduction.

Girolamo Cardano, an Italian physician first mentioned using bone conduction in order to hear better in his book *De Subtilitate* published in 1521— more than 100 years earlier than Bacon’s

mention of ear trumpets! (Mind you, the knowledge of bone conduction was not new. The Greek physician, Galen had written about bone conduction in the second century AD.)

Hearing aid development closely paralleled the available technology of the day. Thus, we can divide the development of hearing aids into five classes based on the technology used. In order of development, hearing aids used acoustic (non- electric), carbon, vacuum tube, transistor and digital technologies.

For the most part, two or more classes of hearing aids were in vogue at the same time. There was often considerable overlap after the invention of the latest technology before the previous technology died out.

As a general rule, as new technology came out, the devices tended to be fairly large. Then, as time went by, they found ways to miniaturize them as much as possible. there were two factors affecting this drive towards ever smaller hearing aids.

First, was the convenience factor. Large ear trumpets were hard to carry around and took up considerable space to use. Smaller devices were much easier to carry around in a pocket and easier and lighter to use.

The smaller size also made them less visible. This appealed to people's sense of vanity—especially the ladies.

Second, there was (and still is) a stigma associated with having a hearing loss (and thus wearing hearing aids). Back then, hard of hearing people were called “deaf and dumb” with “dumb” meaning “mute”. However, it soon came to be associated with “stupid”, and no one wants to be thought of as being stupid. That's why many people won't wear hearing aids today. It was no different back then.

Thus, the trend was to make hearing aids as small and invisible as possible given the technology in use at the time. This also gave rise to disguising hearing aids in numerous ingenious ways so people couldn't tell you were wearing a hearing aid.

## **Acoustic or Non-Electric Hearing Aids**

Acoustic or non-electric hearing aids were the only hearing aids available before the advent of electricity. Their amplification depended on the acoustic characteristics and shapes of the materials used. Some worked very well, and others were essentially useless. Acoustic hearing aids included all sorts of ear trumpets, conversation tubes, auricles ear inserts and bone conduction devices.

Surprisingly enough, acoustic hearing aids didn't die out completely with the invention of more modern hearing aid technologies. In fact, they were manufactured right up to around 1990.

### **Ear Trumpets**

The first ear trumpets probably arose when someone discovered that the hunting horns and megaphones currently in use could be reversed and the mouthpiece held up to the ear to make distant sounds louder.

Initially, this was done to extend the range of hearing for those with normal hearing. But, as often happens with technology, hard of hearing people, or those working with them, saw the possibilities. They quickly adapted the current technology to help people with hearing loss hear better.

About 1640, Italian nobleman, Pietro Amiani, gave us the first known detailed description of a hearing device designed specifically for those with hearing loss. In a section of his book *Geometria* entitled “Hearing Instruments for Those with Weakened Hearing”, Amiani describes a desirable ear trumpet that had a sophisticated parabolic design.



Fig. 1. Early animal horn ear trumpets may have looked like this Bison ear trumpet.

The earliest ear trumpets were made from natural materials such as hollowed out cow and rams horns (Fig. 1) and some snail-shaped seashells.

However, near the end of the 18<sup>th</sup> century, entrepreneurs and “scientists” got together and began designing and manufacturing ear trumpets and making them readily available.

Frederick C. Rein is credited with establishing the earliest manufacturing firm to primarily make hearing aids. Rein was producing hearing aids in London, England as early as 1796.

At their simplest, ear trumpets consisted of a tapered tube that compressed (amplified) captured sounds, and at the same time, funneled them to the listener’s ear. However, it didn’t take long for hearing aid designers to realize that if they flared the end of the tube, or added a resonant bowl, they could increase the amplification

The first ear trumpets were fairly large devices (Fig. 2). Typically they ranged from 38 - 66 cm (15” - 26”) long and had openings (bells) of 13 - 18 cm (5” - 7”) in diameter.

Since long ear trumpets were hard to carry and took up a lot of space to use, it didn’t take long before some imaginative inventors shortened their ear trumpets by making them in shapes resembling bugles. For example, around 1850 Jean Bonnafont decided the extreme length of some ear trumpets then in current use were both inconvenient and unnecessary. He folded the tube of the trumpet into four right angles (Fig. 3) to make a much more compact ear trumpet.

As time went by, ear trumpets continued to shrink so that by 1890 or so many ear trumpets were around 25 cm (12”) long and collapsed into shorter sections for ease in carrying them (Fig. 4). When collapsed, their overall length was 15 - 18 cm (6” - 7”) or less— small enough to carry in a pocket or purse.



Fig. 2. This F. C. Rein collapsible metal ear trumpet was 66 cm (26”) long and had a 17.8 cm (7”) bell (c. 1850).



Fig. 3. This “Bonnafont” (bugle-shaped) ear trumpet (c. 1890) was just under 23 cm (9”) long.



Fig. 4. This three-section hard- rubber ear trumpet is shown collapsed to 17.8 cm (7”) (c.



Fig. 5. The high-powered “Dipper” was 41.9 cm (16½”) long while the bowl was 12.7 cm (5”) in diameter. In 1876, it sold for \$4.50.

Higher-powered ear trumpets had large resonant bowls to capture more sound. One of these was colloquially called “the Dipper” (Fig. 5) since it resembled the shape of an early dipper for dipping water out of a water barrel. It’s large size and large bowl made it the high-powered hearing aid of the 1880s. As a matter of interest, the large bowl collected and emphasized lower-frequency sounds. Thus, it sounded rather bassy.

In contrast, tiny dome-shaped ear trumpets, because of their small size, emphasized higher-frequency sounds. Thus, they produced much more treble and tinnier sounds.

Many of these were in the shape of parabolic domes (Fig. 6) patterned after the dome of St. Paul’s Cathedral in London. Hence they were called “London Domes”.



Fig. 6. This tiny “London Dome” ear trumpet was 6.7 cm (2½”) high and had a bell diameter of 4.4 cm (1¾”). A person could easily hide it in their cupped hand (c. 1900).

Besides making ear trumpets small enough to hide in your hand, there were other ingenious ways of hiding hearing aids in plain sight—even larger ear trumpets. One clever way was integrating the ear trumpet into the top of a walking stick (Fig. 7).



Fig. 7. Rare walking-stick ear trumpet

No one knew you were carrying your hearing aid with you. With your hand over the top, it looked just like any other walking stick. If you wanted to talk to someone, you simply raised it up to your ear and swung the ear tube to the ear you wanted to hear with. When finished talking, you swung the ear tube straight and continued on your way, using your hearing aid as a walking stick again.

## Conversation Tubes

Conversation tubes were a different kind of long ear trumpet. Unlike ear trumpets that could pick up sound from some distance, conversation tubes were designed to pick up sounds directly from the speaker’s mouth. Thus, you had to be close to the person you were talking with and put

(1875).

your lips right up to the bell end of the conversation tube (Fig. 8). A typical conversation tube was around 106 cm (42") although they ranged somewhat in length.

A surprising thing is that when used properly, these conversation tubes worked wonderfully well—some seniors today find they work even better than their fancy, modern hearing aids. Unfortunately, conversation tubes aren't as convenient to use as are modern hearing aids. Since conversation tubes worked so well, they were still being manufactured and used as late as 1976 in the UK.



Fig. 8. A longer conversation tube at 142 cm (55 $\frac{3}{4}$ ") with wooden earpiece & hard-rubber bell (c. 1860 – 1880).



Fig. 9. Ladies rare, but beautiful, imitation mother-of-pearl auricles (1915). Each auricle was about 10 cm (4") long.

### Auricles

Auricles (Fig. 9), a special kind of ear trumpet, had a big advantage. They were the first “hands-free” hearing aids. A headband held them to your head, or a wire ear-hook hooked over your ears. Auricles were either for one ear, or for both ears. Double auricles were the first binaural hearing aids.

### Ear Inserts

As you might expect, there were a number of quack hearing devices sold to an unsuspecting public such as the Vibraphones (Fig. 10) invented by lawyer Charles Fensky. They didn't do anything to help your hearing, but definitely made your wallet lighter!

### Bone-Conduction Devices

Some of the earliest “hearing aids” were held against the teeth and thus transmitted sounds to the inner ear via bone conduction. There are published reports of such devices as early as 1521. However, “dental hearing aids” did not become popular until Richard Rhodes of Chicago, IL patented and began selling his Audiphone in 1879. The next year, a competitor put out the Dentaphone (Fig. 11).



Fig. 10. Vibraphones (1925) were quack devices—they simply didn't work. This pair of sterling silver Vibraphone's measured 1.9 cm (3 $\frac{3}{4}$ ") along each side of the “L”.





Fig. 11. Dentaphones were bone conduction hearing aids. The user flexed them against their upper teeth (1880). When unfolded and in use, Dentaphones were not small—35.5 x 23.7 cm (14" x 9 3/8"), making it impossible for people not to notice them!

## Carbon Hearing Aids (1898 – 1939)

Acoustic hearing aids were the sole technology used until electricity was harnessed and the new-fangled carbon hearing aids came out. Carbon hearing aids were the earliest electric hearing aids. The first carbon hearing aid was produced in 1898. Carbon hearing aids had their heyday from then until the beginning of World War II when they finally died out.

There are two particularly interesting things about carbon hearing aids. One is that you couldn't lay a carbon microphone flat. If you did, the carbon shot or carbon dust in the microphone only touched the lower contact and current couldn't flow. When held at an angle or vertically, the carbon shot or dust touched both the rear conductor and the diaphragm (front conductor) at the same time and voilá—sound!

The second thing about carbon hearing aids was the creative method they used to produce more volume. In order to get more volume you needed to increase the current flow. According to Ohm's Law, you can do this by reducing the resistance of the circuit, or by increasing the voltage. They typically chose to reduce the overall resistance by wiring multiple microphones in parallel. The more microphones in parallel, the less the resistance and since for the same voltage, if you halve the resistance, you double the current and thus the volume of the carbon hearing aid.

As a result, there were carbon hearing aids with 1, 2 or 4 microphones, and less commonly more. A dining room table model in the Museum consists of 3 double carbon microphones (Fig. 12). Carbon hearing aids typically ran on 3 volt or 41 2/3 volt batteries.



Fig 12. The Acousticon Dining Table Model carbon hearing aid had 6 microphones—2 on each side (1908- 1910).



Fig. 13. The Acousticon Model 28 carbon hearing aid—a lower- powered single carbon microphone hearing aid shown in its resonant case (1927).

Higher-powered carbon hearing aids had two microphones (Fig. 14) typically housed in a one-piece case. The microphone could be in a “lunch-box” or worn around the neck. High powered 4-microphone carbon hearing aids (Fig. 15) typically were housed inside “lunch-box” sized tabletop cases.



Fig. 14. The Acousticon Model SRD was a medium-powered double carbon microphone hearing aid. You could wear the double-carbon microphone around your neck or clipped to your shirt-front (1910 – 1928).



Fig. 15. The high-powered (4 microphone) Acousticon Model RF carbon hearing aid had a six-step volume control on the left end of the case to reduce the volume if it was too loud (1910 – 1923).

## Body-Worn

By around 1930, carbon hearing aids had shrunk in size (so had their batteries



Fig. 16. The “tiny” Electro-Ear Model 5 wearable carbon hearing aid had internal batteries (c.1938).

(Fig. 16).

## Vacuum Tube Hearing Aids (1921 - 1953)

With the invention of a practical triode vacuum tube, numerous hearing aid manufacturers began building vacuum-tube hearing aids. Vacuum-tube hearing aids required two batteries, a 11?2 volt “A” battery to heat the filament, and a 45 volt “B” battery to provide the plate current. Over time, with smaller and more efficient vacuum tubes, they got the “B” battery down to 15 volts and consequently, much smaller in size.



Fig. 17. The Globe “Vactuphone”—the first commercially- produced vacuum tube hearing aid (1921). This Vactuphone hearing aid still works after all these years. The tube is now 92 years old!

By the mid 1940s, vacuum-tube hearing aids had shrunk to a wearable size, but the large batteries were still too big to fit into the hearing aid case and just “floated around” outside the aid. As a result, they were referred to as “two-piece” hearing aids. The Zenith Radionic Model A3A was a popular hearing aid from 1944 to 1946 or so (Fig. 18). Men typically carried the batteries in a pocket, while the ladies carried theirs in a cloth pouch strapped to their upper leg.

### Body Worn (One-Piece)

Around 1947, with the advent of 15 volt “B” batteries and smaller, more efficient vacuum tubes, hearing aids finally could have internal batteries. These “one-piece” hearing aids were much easier to wear and I’m sure the ladies rejoiced.

Around 1950 hearing aids could be made small enough that manufacturers made some interesting aids that could be in “hidden plain sight”. For example, Acousticon came up with an unusual hearing aid that was worn on the wrist (Fig. 19).

### Table Top

The first commercially-available vacuum- tube hearing aid was made by the Globe Ear-Phone Company of Boston, MA in 1921. They named it the Vactuphone (from VACuum TUBE telePHONE) (Fig 17).

Two years later, in 1923, the Western Electric Company also began manufacturing vacuum-tube hearing aids. Their first hearing aid was a binaural model—Model 10-A. This was a an enormous hearing aid—probably the all-time largest hearing aid made. It weighed an incredible 220 pounds and was housed in a cabinet 122 cm (48”) long, 91 cm (36”) high and 25 cm (12”) deep. It cost \$2,250.00 back then. With inflation, that would be equivalent to around \$29,000.00 in today’s dollars.

### Body Worn (Two-Piece)



Fig. 18. The Zenith Model A3A-B3A “Radionic”—a two-piece vacuum-tube hearing aid. The large “B” battery is on the left and the round “A” battery beside it (1944).





Fig. 19. Acousticon's Model A-165 was the only wrist-worn vacuum-tube hearing aid ever made (1950).



Fig. 20. Acousticon's Model A-200—a rare double-barrette vacuum-tube hearing aid for the ladies (1951).

For the ladies, Acousticon designers created a vacuum-tube hearing aid that masqueraded as a beautiful faux tortoiseshell double-barrette (Fig. 20).

## Transistor Hearing Aids (1952 - ~2005)



Fig. 21. Sonotone's Model 1010 hybrid (1 transistor & 2 vacuum tubes)—the first hearing aid in the world to use a transistor (Dec, 1952).

Vacuum tube hearing aids had their heyday from the mid 1940s to 1952. Then, almost overnight, vacuum tube hearing aids went the way of the Dodo bird when, in December of 1952, Sonotone came out with their Model 1010 (Fig. 21). This was the world's first hearing aid with a transistor in it. (Actually, this hearing aid was a hybrid—containing 1 transistor and 2 vacuum tubes.)



Fig. 22. Maico's Model O "Transist-Ear" was the world's first all- transistor body hearing aid

(Jan, 1953).

About 3 weeks later, in January 1953, Maico released their Model “O” (Fig. 22), the first all-transistor hearing aid in the world. By the end of 1954, all hearing aids were transistorized, and vacuum-tube hearing aids were no more.

Did you know that hearing aids were the very first commercial application of the transistor? Transistor radios came later.

## Body Worn



Fig. 23. The Zenith “Royal” vacuum-tube hearing aid was one of Zenith’s last vacuum tube hearing aids made (Feb, 1952).



Fig. 24. The Zenith “Royal T” was Zenith’s first all-transistor hearing aid (Feb, 1953). It was the same size as the “Royal” vacuum-tube aid. Note that it had a t-coil built in—called a “phone magnet” in those days.

The first transistor hearing aids looked almost identical to the vacuum tube models that preceded them. For example, the Zenith “Royal” (Fig. 23) vacuum tube hearing aid of 1952 and the Zenith “Royal T” (Fig. 24) transistor hearing aid of 1953 were the same size. The difference was inside. However, it didn’t take long before the size of transistor hearing aids had shrunk considerably.



Fig. 25. The humongous Zenith “Diplomat” BTE hearing aid—Zenith’s first BTE hearing aid (Jun, 1956).

## Behind-The-Ear (BTE)

It only took three years until hearing aids had shrunk so much that they could be worn behind the ear. One of the first BTE aids was the humongous (by today’s standards) Zenith Diplomat (Fig. 25) that came out in June, 1956. It had an external receiver. Today’s hearing aids, instead of using just three transistors, use millions of transistors in dual-core processors.

## In-the-Ear (ITE)

Early in-the-ear (ITE) hearing aids looked pretty crude by today’s standards. But back in 1965, the Telex Model 23 ITE hearing aid (Fig. 26) was state of the art.



Fig. 26. The Telex Model 23 “Electron Ear”—an early ITE hearing aid (1965).

## Eyeglass

Eyeglass hearing aids actually predated BTE aids by a year or so. The world’s first fully-contained, transistorized, eyeglass hearing aid was Otariion’s L10 “Listener” (Fig. 27). It came out in Dec, 1954.



Fig. 27. The Otariion Model L10 “Listener”—the world’s first transistorized, eyeglass hearing aid (Dec, 1954).

## Digital Hearing Aids (1996 – Present)



Fig. 28. The Oticon Model DFC “DigiFocus Compact” BTE—one of the first completely-digital BTE hearing aids made (1996).

For a number of years, hearing aids, were made with discrete components, then, with the invention of integrated circuits, the power and functionality of hearing aids increased dramatically. The digital revolution of the 1980s spawned digitally-programmable analog hearing aids. Then, in 1996, Widex came out with their “Senso”, and Oticon came out with their “DigiFocus Compact” (Fig. 28) BTE aids. These were the first commercially-successful, fully-digital hearing aids produced.

## Hearing Aids Batteries

Nothing illustrates just how far hearing aids have come in the past 100 years than in the size of the batteries that powered them. Compare the large No. 57 battery used in Acousticon hearing aids of 100 years ago with the tiny No. 5 Panasonic



Fig. 29. The Acousticon No. 57 hearing aid battery—one of the largest hearing aid batteries made contrasted with the tiny Panasonic No. 5 battery—the smallest hearing aid battery made.



button  
cell that  
came  
out in  
2008  
(Fig.  
29). The  
tiny No.  
5 was  
the  
smallest  
hearing  
aid  
battery  
ever  
made. It  
was so  
small it  
was  
about  
the size  
of one  
of the  
terminal  
s on the  
No. 57  
battery.

## Looking Ahead

Fifty years from now, who knows what hearing aids will look like, or indeed, if we will even be using hearing aids then because of advances in hair cell regeneration and other medical advances. It may be that by then hearing aids will be extinct and the only places you will see them will be in museums such as The Hearing Aid Museum.