PCARA Update

Volume 11, Issue 10 Peekskill / Cortlandt Amateur Radio Association Inc. October 2010

Fall fest fling

What better way to spend an Autumn Satuday morning, than at a hamfest? The Bergen Amateur Radio Association's Fall Hamfest is on October 9, 2010 (http://www.bara.org/). A great opportunity to pick up some items for projects to keep busy over the long Autumn and Winter nights!

Buyers hover like birds of prey around a fresh pile of desirable equipment at the Candlewood ARA Hamfest on September 12. Far right, waiting to pounce, is Mike N2EAB.

The New York QSO Party begins on Saturday October 16, 2010 at 1400 UTC for 12 hours. Full details are available at the website http://www.nyqp.org/. We will be discussing PCARA's participation in the contest at our October meeting. This year as last, PCARA is sponsoring a plaque.

Remember that our next meeting is on October 3, 2010 at Hudson Valley Hospital Center. I look forward to seeing each of you there.

- 73 de Greg, KB2CQE

Newsletter kudos

From the August 2010 Hudson Division Beacon (http://www.hudson.arrl.org/pages/hudsonbeacon.htm) we learn that last month's issue of *PCARA Update* was awarded "Division Newsletter of the Month".

This is the seventh time in five years that PCARA's newsletter has been recognized. We thank all contributors to the newsletter — including, from September's bumper issue: Karl, N2KZ, Greg KB2CQE and Ray W2CH. Thanks also to ARRL Hudson Division director Frank N2FF.

ARRL members can subscribe to the e-mail version of the Hudson Division Beacon from the 'Members Only' portion of the ARRL web site.

PCARA Officers

President:
Greg Appleyard, KB2CQE, kb2cqe *at* arrl.net
Vice President:
Joe Calabrese, WA2MCR; wa2mcr *at* arrl.net

Net night

Peekskill/Cortlandt Amateur Radio Association holds a weekly net on the 146.67 MHz W2NYW repeater on Thursdays at 8:00 p.m. Join net control Karl, N2KZ for neighborly news and technical topics.

Contents

Adventures in DXing

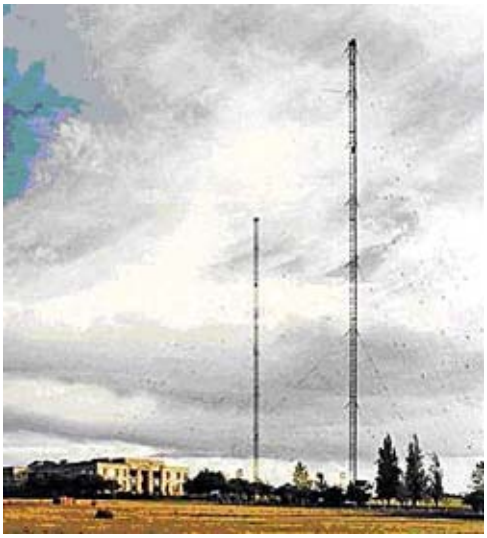
– N2KZ

The Lowdown

Get ready for a new frontier! In a couple of years, you may be able to try the 600 meter band! The FCC and the NTIA (National Telecommunications and Information Administration) plan to propose a new ham band in two parts — 461 to 469 and 471 to 478 kilohertz just below the AM Broadcast Band — at the World Radiocommunication Conference to be held in Geneva, Switzerland in 2012. If the band is approved, a whole new world will be yours!

Radio pioneers have already tested these waters. 45 American stations are operating with 20 watts on 495 to 510 kHz as participants under the ARRL's experimental license WD2XSH using CW, PSK-31 and MSK-31 modes. Several other countries have joined in: New Zealand, Iceland, The Netherlands, Sweden and Canada. Great challenge and potential waits! Many contacts have been made between America and Canada. WD2XSH stations in Oregon and Mississippi have been heard on the Marshall Islands in the Pacific!

Longwave has fascinated hobbyists since the beginning of radio. Before electronic oscillators were designed, large mechanical Alexanderson alternators created CW radio signals up to about 100 kHz. Starting in the 1920s, very tall antennas, combined with elaborate ground systems, were built for modern longwave broadcast stations providing wide-area coverage in Europe. A few of these stations are still on the air to the delight of DXers worldwide.



The BBC Long Wave transmitter at Droitwich, England came on-air in 1934. Two 700 foot steel masts, 600 feet apart, hold up a wire "T" antenna for 200 kHz . It is still on-air today on 198 kHz.

Historically, 500 kHz (and its surrounds) served as a meeting place for long-distance marine communications. Legendary stations along the Atlantic seaboard would communicate daily with vessels across the open seas. Coastal stations like KPH Point Reyes, California and EJM Malin Head, Ireland handled ship-to-shore traffic on medium wave over thousands of miles at night. Important information was exchanged over-the-air continually.

The Longwave Club of America (lwca.org) has a wealth of information waiting for you to discover. Established in 1974, the LWCA is a Mecca for all who enjoy really low bands. LWCA members have been using long and medium wave frequencies for experiments for decades.

The LWCA can provide a great education regarding the world below 600 meters. For example, under FCC Part 15, you can operate with one watt between 160 and 190 kHz — or on 510 through 1705 kHz at 100 milliwatts — no license required! Two-way QSOs are not out of the question. Skeds have produced handshakes between stations hundreds of miles apart.

MF antenna with capacitor hat.

Back in the 1980s, I put a Part 15 'medfer' on the air from my QTH in Croton-on-Hudson, New York. I used a modified LPB tube type transmitter with a ten foot antenna (with capacitive high-hat) and ground system on 530 kHz. This was before the onslaught of Highway Advisory Radio transmitters on 530 kHz — most notably at the Tappan Zee Bridge and along I-287. Using just my car radio, I managed to hear my AM-modulated CW signal as far away as Stillwater Lake at Fahnestock State Park. Not bad for 100 milliwatts!

My method of sending continuous CW was mechanical. I used a little module that originally was part of a beacon aboard an old Japanese fishing vessel. It was a tiny motor built into a cylinder with an octal plug at the base for connection. It looked like a stubby metal vacuum tube. The motor would slowly turn like the second hand of an old analog clock. A notched disk would rotate around and around as a micro-switch 'read' the bumps in the disk. The micro-switch would open and close as it turned over and over again. This action switched the audio tone feeding the transmitter on and off creating an automatic code key. I retained the original ship's identifier "Y12." Using a tiny jeweler's screwdriver, you could reposition the little

metal bump tabs to create a different short message in Morse.

The key to operation on 600 meters is an efficient ground system. In the world of professional medium wave broadcasting, a typical installation consists of a vertical antenna sitting in the middle of a ground mat constructed from 120 radials (a quarter wavelength or more in length.) Do the math: 120 radials at about 150 meters long (600 meters divided by four: approximately 450 feet) adds up to a lot of wire (and a lot of work!) Compromise must be found!

FCC Part 15 demands your antenna be no longer than 3 meters in height. To find resonance, you must use an efficient loading coil. I used #10 solid wire for my coil. A capacitive high-hat can be built to improve the design. Along with the high-hat at the top of the antenna, I used a ten radial ground mat to create a good connection with Mother Earth. Unfortunately, my house and trees got in the way of my ground mat's symmetry. You do the best you can! The result is a very high-Q antenna meant for one very single frequency only. Move five or ten kilohertz and you must re-tune. In fact, I found that ground moisture and weather could de-tune the system easily.

The loading coil was an adventure in itself. I used a form made from four-inch white PVC pipe to make the coil concise and effective. I bared four notches in each turn and experimented with an alligator clip to determine where I reached best resonance. You have to go up and down the coil patiently searching for the 'hot spot.'

Loading coil for MF wound on PVC pipe.

The alligator clip was connected to your transmitter's output. The top of the coil fed the vertical antenna. Using a field strength meter, you gain a good understanding of what high-Q means! Only a half a turn, one way or another, might change your output dramatically. When you reached resonance you knew it. Wow! What a signal!

If approved, the new 600 meter ham band probably won't have any restrictions on antenna structure and height. Hams will surely utilize the classic inverted L design, quite popular on 160 meters. For 160, you use a piece of wire about 135 feet long. The strategy is to raise the wire up as high as you can vertically and then fly the remainder to a tall nearby tree or tower. At 600 meters, the same would be true except the wire would need to be considerably longer. Again, an efficient loading coil with capacitor matching system would be essential for success.

Learn about the progress and achievements that have already been made on longwave and you'll understand the potential here! Twenty watts (or more) on medium wave will equate to enormous fun! It's bound to be a hotbed for homebrew equipment, antennas and ground systems! Lines to purchase ground wire are already forming outside of Home Depot!

It would be a lot of fun to re-visit the world of medium wave, especially with much higher power and other stations waiting ready to work you. I certainly hope this allocation is approved. 600 meters would be a great place to operate. I can't wait!

AM on FM

Three major 50,000 watt clear channel AM broadcast stations have recently decided to simulcast their news-talk formats on FM. WBAP 820 AM, Dallas, Texas, WSB 750 AM, Atlanta and WGY 810, Schenectady, New York have become AMs with FM sister stations. All three stations can be heard at night on AM here in the New York City area.

Some possible reasons for these moves have been discussed in the broadcast trade press. All three stations already attract large audiences but many people don't (or can't) listen to AM. Simulcasting will increase their already dominant audience numbers. New regulations may impose higher royalty fees for playing music on the air. Talk radio plays little or no music. Simulcasts are inexpensive to put on the air and vastly cheaper than retaining the large staff necessary for a music station. It's all about money!

This new trend seems counter-intuitive to the marketing approach of the proponents of HD Radio. One of the main selling points of HD Radio multicasts was to bring great variety to listeners without needing a subscription (like satellite radio.) Yet, many AM news-talk radio stations are simulcast on FM sister stations' HD Radio subchannels. In New York, Sports radio WFAN is on WXRK 92.3 HD-3, Westchester's WVOX-AM is on 93.5 WVIP HD-3, WNYC-AM is on WNYC 93.9 HD-3, WCBS-AM is on WCBS-FM 101.1 HD-3, and WINS is on WWFS 102.7 HD-3. Simulcasting powerhouse AM stations directly on FM only continues this trend.

Simulcasts are not limited to AM programming being heard on FM. In the past few days, an FM station in the Hamptons on Long Island, has dropped its local talk programming to simulcast New York City's WPLJ pop-rock format. Citadel's WXLM 104.7 has become WELJ. This is an opposite flip, but the intent is the same. It will improve the owner's bottom line.

What is going on? Radio business analysts agree that these moves are motivated by finance. The advent of iPods and Internet radio continues to shrink radio audiences. Young people simply don't listen to the radio since little is targeted toward their demographic and, to their ears, commercials and clutter are intolerable. iPods don't suffer from interference or fade away inside buildings! Station owners know that money is tight. Large broadcast groups, like Clear Channel, Citadel and Cumulus can't afford to support multiple full-fledged radio stations in one market and still make a profit. Radio has a new philosophy: Adapt or die!

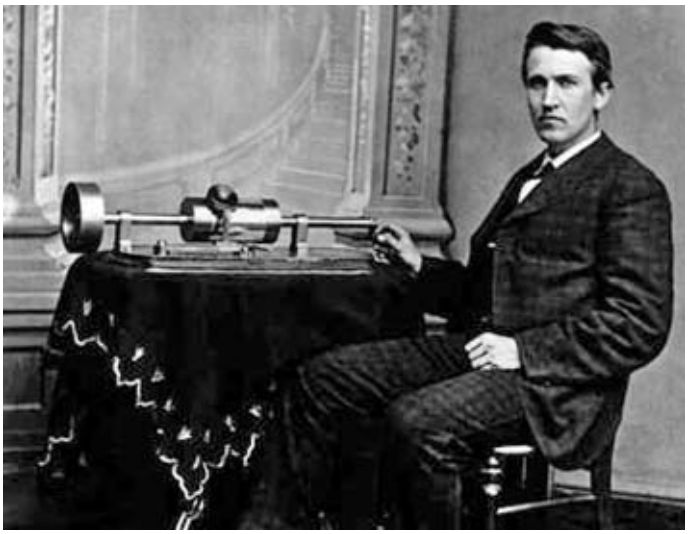
Until next month, 73s and dit dit from N2KZ 'The Old Goat.'

Essential$_2$ records

The recording industry has used many different materials and techniques over the years. In keeping with previous Essential$_2$ articles, we'll concentrate on the *materials* involved in this fascinating story, and on their chemistry.

A sound start

The tale begins with Thomas Edison's phonograph, invented in 1877. Edison had been using a rotating paper disk to record telegraph signals, and he moved on to the recording of sound using similar principles. Edison designed an instrument in which sound waves met a diaphragm, which moved a needle. The needle then left a mark on a moving sheet of tinfoil. In Edison's patent, the tin foil is wrapped around a grooved metal cylinder, and rotated with a hand crank.



Thomas Edison pictured with his phonograph in 1878.

The needle and tin foil recorded incoming sound waves as hill-and-dale impressions that could be played back by returning the needle to the starting point and rotating the cylinder again. Metallic tin (not tin plate) is a readily deformed material that was easily marked by Edison's vibrating needle. Unfortunately, this same property of the tin foil meant that recordings could only be played back a few times before the needle deformed the tin even more.

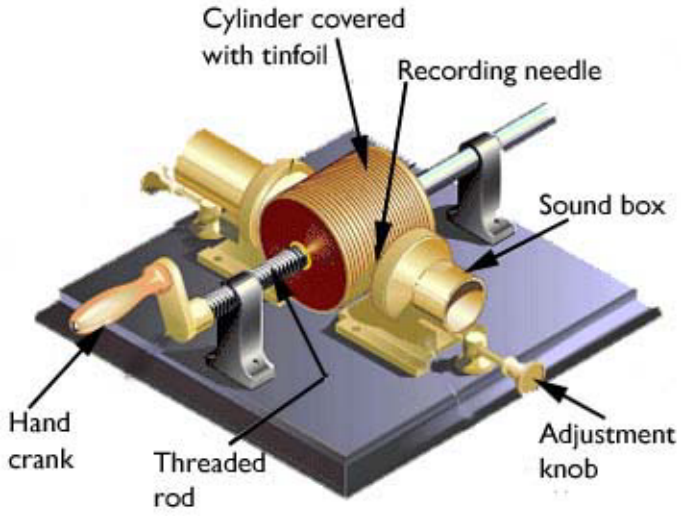


Diagram of Edison's 1877 phonograph.

Lateral thinking

Alexander Graham Bell and his associates replaced Edison's tinfoil with a layer of Ozokerite wax on a metal cylinder or disk. Ozokerite is a naturally-occurring, hydrocarbon wax with a melting point of 60 -75 deg C that can be deformed by pressure. Bell's team tested side-to-side (lateral) recording as well as Edison's hill-and dale approach. Their work was patented in 1886 and the companies formed to exploit these techniques evolved into Columbia Records.

Around the same time, Emile Berliner developed a way to record sound on disks using lateral movement of a stylus as it traced a spiral onto a metal disk coated with beeswax. This zinc disc was then immersed in an acid bath, which etched the metal away wherever the stylus had removed the wax coating. This metal disk could be used to stamp impressions on a ball of hard rubber (vulcanite). The resulting disks could then be played on a device that Berliner called a 'Gramophone'.

German inventor Emile Berliner worked for Bell Telephone, before moving to Washingon, DC.

Berliner teamed up with Eldridge Johnson, who had designed a clockwork spring-wound motor to drive the gramophone disk at constant speed. Together, they founded the

Victor Talking Machine Company in 1901, later purchased by RCA in 1929.

The material used with the metal stamper for molding the final disk changed from hard rubber to "shellac", a formulation of shellac itself, resin, fillers and lubricant. Shellac is a special resin, scraped from trees where it has been secreted by the Asian Lac insect. The finest quality comes from India. (Shellac had other uses in radio and electronics, where it was dissolved in alcohol then used to impregnate inductor and transformer windings. After the alcohol evaporates, the shellac holds the turns of wire in place and acts as an insulator.)

This famous painting by Francis Barraud of fox terrier Nipper listening to "His Master's Voice" was modified to include a Berliner disk gramophone.

Shellac granules from India.

Electrical boost

The first few decades of recording relied on the unaided energy of sound waves, captured in a horn, to move the diaphragm and drive the cutting needle. As electronic tubes and amplification were developed around 1910-1920, there was a move toward capturing the sound waves electrically before cutting the master disk. In the early 1920s, the Western Electric Company successfully developed an electromagnetic disk cutter, driven by the electronically amplified signal from a recording microphone. Even though amplification could now be used in the recording path, mechanical phonographs were still the most popular for domestic playback. The model pictured here is a Victor-Victrola IX, recently purchased for restoration by my colleague Matt Reynolds. Sound passes from the pickup arm through a horn housed inside the cabinet — just below the double spring motor — then emerges through the open cabinet doors. This model was manufactured in 1915, but the same design was still available from Eldridge Johnson's "Victor Talking Machine Co." of Camden, NJ until 1926.

Victor Victrola IX mechanical phonograph.

The basic materials and techniques for pressing 78 rpm records continued without major change until the 1950s. The next significant step saw a move away from shellac as the molding compound to a much more modern material.

Western Electric engineer George Groves using a 1925 Westrex Cutting Machine.

The age of vinyl

78 rpm records were brittle and could only last around 3- 5 minutes per side. In order to squeeze more grooves onto the disk surface, and to reduce the surface noise, a new molding material was needed to replace shellac — this was "vinyl" or polyvinyl chloride, also known as PVC. It was first introduced during the 1930s for broadcast 'transcription' recordings and from about 1948 for long playing (LP) records. As mentioned in a previous episode of "Essential$_2$" *(PCARA Update,* July 2006), PVC is a polymer that your reporter is familiar with. PVC is prepared by reacting ethylene and chlorine to form dichloroethane (ethylene dichloride), followed by heating to form vinyl chloride monomer. The monomer is polymerized in a watery emulsion or suspension, resulting in a white powder.

$$CH_2{=}CH_2 + Cl_2 \rightarrow ClCH_2CH_2Cl$$
Ethylene Chlorine Dichloroethane

$$ClCH_2CH_2Cl \xrightarrow{heat} CH_2{=}CHCl + HCl$$
Dichloroethane vinyl chloride hydrogen chloride

Vinyl molding compound for $33^1/_3$ rpm LP records and 45 rpm singles consists of a copolymer of polyvinyl chloride/polyvinyl acetate, carbon black pigment and thermal stabilizer. PVC decomposes at molding temperatures, so a stabilizer is essential to allow processing. My UK employer previously manufactured the thermal stabilizers and I had some involvement in their testing. At the time (late 1970s), record manufacturers were determined to reduce costs, and the quality of the vinyl compound could suffer.

The manufacturing process for vinyl records in the 1950-1970s was not so different from the process for shellac records developed in the 1920-1930s, except that sound

United Record Pressing Inc. in Nashville TN, where vinyl is still being pressed into long playing records today

recordings were first captured onto magnetic tape rather than being directed straight to disk. But a master disk still had to be cut, then metal stampers prepared. The vinyl compound is melted, and extruded into a metered hot slug which is deposited into the mould at around 170 deg C. The mould, held at about 95 deg C is closed, the molten vinyl flows into the tiny grooves and forms the record.

$33\ ^1/_3$ and 45 rpm vinyl records.

Just in case any of our younger readers have not experienced ownership of vinyl records, it is worth remembering that LPs were 12 inches in diameter, with lots of room for artwork and sleeve notes on the album cover. Playback involved lowering a stylus gently onto the rotating record surface. Vibrations of the stylus were converted into electrical signals through a piezo-electric or magnetic cartridge, then amplified electronically. Repeated playing or excessive weight on the stylus could wear away the vinyl, while dust and scratches would introduce crackles and popping sounds. High-fidelity vinyl records were a wonderful advance, but you had to take very good care of them.

No static at all

The next step in recording was revolutionary — the change from all-analog records to digital technology took place around 30 years ago. A team of engineers from Philips and Sony developed digital records as a spin-off from the Laserdisc technology used for video recordings. The audio "Compact Disc" (with a final 'c', not a 'k') was introduced commercially in 1982. The standard Compact Disc is 12 centimeters in diameter (a little under 5 inches) and is made from **polycarbonate**, with a thin, reflecting layer of aluminum on the top, protected by a film of acrylic lacquer.

Polycarbonate is an amazingly strong, light, crystal clear plastic, manufactured from two rather dubious starting materials. One of these is is phosgene, $COCl_2$, notorious as a poison gas from World War I. The other is bisphenol A, abbreviated to BPA, a product made from acetone and phenol.

Making it crystal clear

In the polycarbonate manufacturing process, bisphenol A is first reacted with sodium hydroxide to form a phenoxide. This phenoxide is then reacted with phosgene to produce a chloroformate, which is attacked by another molecule of phenoxide. This process repeats, producing a lengthening chain that is the polycarbonate molecule:

$$(NaOC_6H_4)_2CMe_2 + COCl_2 \rightarrow NaOC_6H_4CMe_2C_6H_4OCOCl + NaCl$$
Sodium phenoxide Phosgene Chloroformate

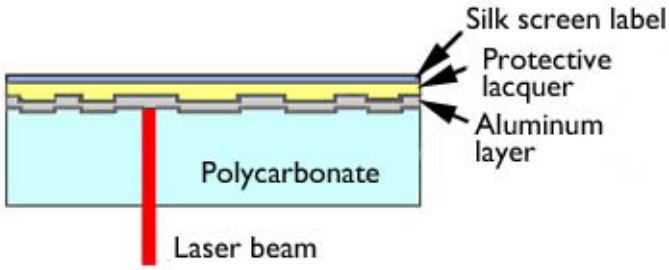
$$NaOC_6H_4CMe_2C_6H_4OCOCl + (NaOC_6H_4)_2CMe_2 \rightarrow [\text{-}\ OC(OC_6H_4)_2CMe_2\ \text{-}]_2 + 2\ NaCl$$
Chloroformate Sodium phenoxide Polycarbonate repeating unit

The process for manufacturing an audio Compact Disc from polycarbonate plastic goes like this. The original master recording made on a digital medium such as digital audio tape, is transferred to video tape or hard disk along with other codes for indexing and tracking. This pre-master is used to generate a disc master by controlling a laser which cuts a groove with pits and lands in a layer of photoresist material spun onto a glass disc. The exposed areas of the groove are then removed by chemical developing.

The master disk complete with exposed photoresist

layer is then baked and "metalized" by exposure to nickel vapor at low pressure, followed by electroplating with more nickel. The metal 'father' undergoes a further electroplating process to form 'mothers' with a positive impression of the pits and lands.

In the production process, pellets of polycarbonate are fed into an injection molding machine containing a metalized stamper derived from a 'mother' disc. The polycarbonate is melted and injected at around 280 deg C into the mould. The molten polycarbonate accurately flows around the raised areas on the stamper, forming millions of pits. Cooling water then fills the mould to solidify the polycarbonate and allow removal from the mould.



The layers of an audio CD. Molten polycarbonate flows into the mould, forming pits and lands on the polymer's top surface. This surface is coated with aluminum to reflect the laser beam shining from below. A protective lacquer layer is added to prevent scratches and corrosion. The label is then screen-printed in one or more colors.

Next, the polycarbonate disc is coated with aluminum on its top surface to cover the pits and lands, and reflect light shining up from below. This is accomplished in a vacuum chamber in which aluminum is heated and the resulting vapor is accelerated by an electric field onto the disc surface. The disc is then spin-coated with acrylic lacquer for protection, followed by screen printing of the label.

Breakdown products

I already mentioned that phosgene, one of the materials used to manufacture polycarbonate, has a notorious past. The other ingredient of polycarbonate — bisphenol A (BPA) — has also acquired a very bad reputation recently. Polycarbonate containers — sometimes identified by the "other" recycling number of "7", can degrade back to bisphenol-A when cleaned with harsh detergents or chemicals such as sodium hydroxide. As a result, despite industry reassurance, there has been growing consumer resistance toward its continued use in food-contact applications or for drink containers.

This bottled-water container is made from polycarbonate plastic with recycling symbol: "7".

Bisphenol A is also used to produce the epoxy lining on the inside of canned food and drink, where BPA may leach out of the internal coating into the consumed product. Public concern has been growing in this area also.

Internal surface of a tin can is protected by an epoxy resin coat manufactured from Bisphenol A.

A third source of exposure to BPA that has only recently come to light is the coating on some carbonless copy papers and thermal printing papers, such as the paper rolls used for cash register receipts and airline tickets. The amount of BPA on a typical receipt is much higher than in bottles and tin can linings, and can be transferred to human fingers.

The concern about human exposure to BPA is that it is an 'endocrine disruptor', meaning a chemical that can interfere with the action of hormones in the human body. The main danger appears to be for infants, and some countries have banned the use of BPA in the manufacture of baby bottles and baby formula cans. The situation is controversial, so watch for further developments. Depending on your point of view, you might want to avoid polycarbonate containers for food and drink, reduce your use of tin cans and wash your hands after handling thermal paper.

Meanwhile, you can feel relatively safe while handling the polycarbonate used in your audio CDs, CD-Rs, DVDs and Blu-ray discs. That tough, clear plastic is not likely to hurt you, unless you break the disk and cut yourself on its jagged edge!

Disappearing disks

Audio Compact Discs.

Your editor still thinks it is a minor miracle that you can walk into a high street store and hand over a few dollars for a small, molded plastic disk containing 680 MB of data on an audio CD; 4.7 to 9.4 GB of data on a DVD or — today's miracle — 25 to 50GB of data on a Blu-ray disc.

And yet the popularity of all these formats is in considerable doubt. The shelves full of Compact Disks that replaced vinyl albums are already shrinking as the majority of people purchase their music online in the form of downloadable computer files. The same thing is happening to DVDs as a growing number of homes acquire broadband connections that are fast enough to stream video from the Internet.

Soon you will be able to regale your puzzled grandchildren with tales of the good old days, when rotating records brought entertainment to the masses for over 130 years.

- NM9J

Peekskill / Cortlandt Amateur Radio Association

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Newsletter contributions are always very welcome!
Archive: http://home.computer.net/~pcara/newslett.htm

PCARA Information

PCARA is a **Non-Profit Community Service Organization.** PCARA meetings take place the first Sunday of each month* at 3:00 p.m. in Dining Room B of the Hudson Valley Hospital Center, Route 202, Cortlandt Manor, NY 10567. Drive round behind the main hospital building and enter from the rear (look for the oxygen tanks). Talk-in is available on the 146.67 repeater. *Apart from holidays.

PCARA Repeaters

W2NYW:	146.67 MHz -0.6, PL 156.7Hz
KB2CQE:	449.925MHz -5.0, PL 179.9Hz (IRLP node: **4214)**
N2CBH:	448.725MHz -5.0, PL 107.2Hz

PCARA Calendar

Sun Oct 3: PCARA monthly meeting, Hudson Valley Hospital Center, 3:00 p.m.

Hamfests

Sun Oct 3: Hall of Science ARC Hamfest, NY Hall of Science, 47-01 111th St., Flushing Meadows, Queens. 9:00 a.m.
Sat Oct 9: Bergen ARA Fall Hamfest, Westwood Regional High School, 701 Ridgewood Rd., Washington Townhip, NJ. 8:00 a.m.
Sun Oct 10: LIMARC Indoor Hamfair, Levittown Hall 201 Levittown Parkway, Hicksville, NY. 9:00 a.m.

VE Test Sessions

Oct 3: Yonkers ARC, Yonkers PD, Grassy Sprain Rd, Yonkers, NY. 8:30 a.m. Contact Daniel Calabrese, 914 667-0587.
Oct 9: Bergen ARA, Westwood Regional High School, 701 Ridgewood Rd., Washington Townhip, NJ. 8:00 a.m. Contact Donald Younger (201) 265-6583
Oct 14: WECA, Westchester Co Fire Trg Center, 4 Dana Rd., Valhalla, NY. 7:00 p.m. Contact Stanley Rothman, 914 831-3258.
Oct 18: Columbia Univ VE Team, 2960 Broadway, 115 Havemeyer Hall, New York NY. 6:30 p.m. Contact Alan Croswell, (212) 854-3754.

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