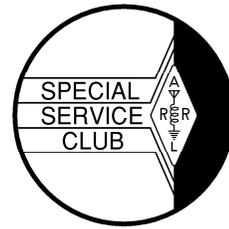




# SIGNAL



de N1NC

October 2003 Volume 12 Number 10

## This Month's Meeting

This month our meeting will be held at regular time and place. That's 7:30 at the Pepperell Community Center.

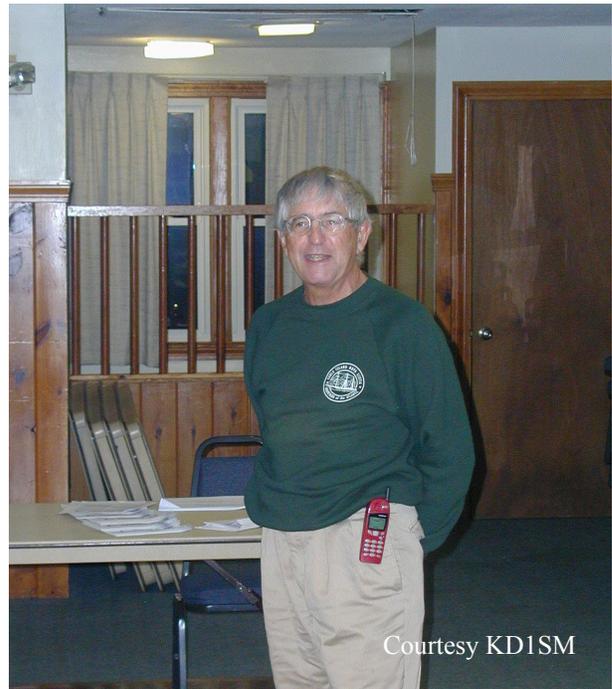
The meeting program will be a QSL Card sort. We will be getting boxes of cards from the W1QSL Bureau that we will sort before they get sent to the "Letter Sorters".

As a reminder to everyone as to how this works. Foreign QSL Bureaus send cards to the US presorted to one of the ten QSL Bureaus. We are in the first area. Hence the "1" in our callsigns. Regardless of where you actually live your cards come in through the area for your callsign number. The next step in the process, which is what we will do, is to sort the cards by the first letter of the suffix or the first letter after the callsign area number. There are a couple of possible situations to consider. Most will be foreign cards for calls in the "1" area so they are straightforward. Some will be from someone in the first call area that will be returned for a number of reasons like broken calls, Silent Keys, and people who are not members of their respective incoming QSL Bureau. They will be marked on the backside as to the reason for return so they are sorted by the original senders call which would be a "one" callsign. There are also cards that are handled by a QSL Manager. They will have a TO and a FROM but will also have a "VIA" followed by a callsign which again should be a "1" callsign. In that case they are sorted by the call sign after the VIA. There will also be missorted cards and cards that cannot be read or interpreted. Any that you are not sure of just put back in the box.

After our sort the cards will be grouped to the 26 letters of the alphabet based on the first letter of the suffix. They then get forwarded to the "Letter Sorters". There is one person responsible for each letter. They

do the final sorting and handle the delivery of the cards. There will be pizza and drinks served after.

## Last Months Meeting



Courtesy KDISM

Our speaker last month was Jim Spears, N1NK. Jim was a member of the 2002 CY0MM DXpedition to Sable Island and had put together a very interesting video presentation on his trip. Jim not only covered the operating at CY0MM. He covered the decisions involved in choosing a location that was desirable DX spot and what it took to organize a DXpedition in terms of logistics and equipment.



Courtesy KD1SM

He also talked about the financial considerations of such an adventure.



Courtesy KD1SM

Jim is the first speaker recipient of the much sought after NVARC logo mug. Thanks to Jim for coming all the way up from R.I. to give his presentation.

### Member Short Presentations

The November meeting program is going to be “Member Short Subjects”. Our goal is to have four members do a ten or fifteen minute presentation on a topic of interest to them.

These presentations don’t have to be radio related. It could be what you do when you’re not “playing radio”, or some other hobby you have.

We currently have two topics and speakers. If you have a short subject of ten or fifteen minutes that you would like to present, contact a Board member. If you need help putting together the slides, need handouts copied, or need equipment we can probably help.

### Adopt-A-Highway

The September clean up took place on the 21st. We had a good turn out and finished our section of road. Thanks to Ralph KD1SM for running this cleanup as I was working at the Jimmy Fund Marathon Walk in Newton that day. Thanks also to Pat N1VAV, Greg N1VAW, Bob W1XP, Jim AA1PO, John KB1HDO.

The next cleanup will take place October 19th. We will meet at the river traffic island at 9:00 A.M.

### Grotonfest



Courtesy KD1SM

September 21<sup>st</sup> we put up the NVARC booth and displays at Grotonfest. Ron W1PLW organized the event for us. Thanks also to Bruce W1BG, Stan KD1LE, Rod WA1TAC, Larry KB1ESR, Les N1SV, Ralph KD1SM, Russ WR1Y, Bob W1XP, and John KB1HDO.



Courtesy KD1SM

Russ brought an old time receiver for the visitors to tune around on and a key and oscillator for Morse code demonstration. After each visitor sent their name in code we handed them a certificate certifying the

recipient has sent his name in Morse code. Stan produced the certificates.

Stan produced the two poster sized displays comprised of pictures from NVARC activities targeted at what might be of interest to the general public. We have used individual pictures in the past but having them framed protects them from the wind and rain and makes set up much quicker. Also stopping by were Bob AB1CV, Herm WW1HR with a friend, and Lynda N1PBL.

### **Review of New ARRL EC009 Antenna and Construction Course**

by Bob Reif W1XP

You may have seen the new antenna course review on page 13 of the October QST, "New Antenna Course Combines Theory with Hands-on Work". I have been involved in the Beta review of the course and am very excited about the course. I think it will fill a niche that has existed for some time in the League's technical program. I couldn't agree more with the review in QST. The presentation is clear and straightforward. The drawing and graphs are first rate. With a minimum of math and a maximum of simple and straightforward demonstrations the author explains some of the basics of antennas so all can understand. There are many construction projects and hands on experiments with the antennas built that demonstrate many of the features of an antenna type. To get the most out of the course expect to build at least some of the antennas and get involved in the student activities part of the course. There are 15 learning units to the course and a final exam. Besides the on line text and graphic material, there is a reference text. Each lesson has a student activities section. The student activities are very good at presenting hands on antenna work for the student. There is some "homework" that has to be sent into the students mentor. Each student has a mentor to answer questions and review the student's activities. It's far more than book learning. The course covers both HF and VHF antennas of all types. The exact date of release is not known yet but watch for it. I expect the word will get out and this course will fill up fast. (Here is some of the word getting out I hope)

73 Bob W1XP

### **From the President**

We put up a good display at Grotonfest. Thanks to Ron W1PLW who organized the event and Earl WR1Y who arranged our space. Thanks also to eve-

ryone who helped set up, take down, and run the display.

This weekend is the Pepperell Fall Classic Soccer Tournament. If you have some time available to help contact John KB1HDO who is organizing support for this event.

Since the Signal is full this month I'll keep it short.  
Stan KD1LE

### **Ham Radio History 101**

Beginning Amateur Radio History

by Bob Reif W1XP

This month we take a bit of a different tack. (The nautical term intended, as you will see.) In early 1923 Dr. Donald B. MacMillan approached the A.R.R.L with an interesting proposal. This month's look at early amateur radio explores the results of that proposal.

WNP

Wireless North Pole, the first Dxpedition

Dr. Donald B. MacMillan was an alumnus of Bowdoin College in Maine and world-renowned leader of scientific expeditions to the Arctic regions. In 1923 he had lead seven cruises of the auxiliary schooner Bowdoin into Arctic waters to study the region. His eight's cruise of 14 months duration was scheduled to leave in late June of 1923 and winter over locked in the ice at a point about 700 nautical miles south of the North Pole between Greenland and Ellesmere Island. One of the purposes of the trip, among others, was to discover the nature of the Aurora Borealis and study the effects on radio wave transmissions in the 200 to 300 meter wavelength region (1.0 to 1.5 MHz). With this in mind and also considering the benefits of radio communication for crew moral, and well being, Dr. MacMillan had approached the A.R.R.L. with the proposal that the League provide an amateur radio operator for the expedition. The board of directors voted to do so and preparations were started on equipping the Bowdoin with wireless equipment. The call at Dr. MacMillan's suggestion was WNP, Wireless North Pole. A search was started for an amateur to go as the operator. Don Mix, 1TS of Bristol, Conn., and a member of the A.R.R.L. staff was selected as the operator.

Manufactures and vendors donated much of the equipment for the Bowdoin. The transmitter and receivers were supplied by Zenith in Chicago. This equipment was designed to fit in the space made available for the radio equipment. It consisted of two

receivers (tuners) one for long waves and one for short waves. The short wave tuner was a regenerative detector and two stage audio amplifier. It covered 850 to 150 meters. The long wave tuner design was the same. The transmitter was a two-tube oscillator design. It was supplied 500 Hz high voltage AC from a special transformer. Keyed AC from a DC motor driven 500-cycle AC generator powered by a 32-volt storage battery supplied the high voltage transformer. An internal combustion engine driven generator charged the 32 volt 160 amp hour battery system. As back up a second charging motor generator was provided.

The antenna used when the Bowdoin was under way consisted of a flat top of wires from the top of the main mast to the foremast and then down to the deck via a bow sprint. The wireless equipment was located in the crew's quarters where a bunk had been removed. While the schooner was frozen in the ice more elaborate antennas were tried. These were suspended from ropes rigged from the boat to high points on shore. The last and largest of these was a fan array of wires suspended by over a half mile of rope passing over the boat at a height of 125 feet. The rope was anchored to rocks on the cliffs surrounding the bay. This last attempt at a better antenna used almost every available length of rope on the boat.

This expedition was looked on with some of the same feeling as the trips to the moon some 40 years later. They were going to one of the ends of the world. For example, the 500 cycle generator needed to be rewound and was sent out by Zenith in Chicago. When it arrived back there was a note on the generator saying "This generator personally rewound by 9BA, 73". Another example, the Burgess Battery Company furnished the radio B batteries for the receivers. They made up 10,000 cells and set them aside to age. They then selected 1000 of the best of these cells for the batteries that would power the tubes in the receivers. These batteries were to last the 14 months of the voyage, but they also sent spare cells and chemicals to provide batteries for another two and one half years. People on these types of expeditions didn't always make it back on schedule. Some didn't make it back at all. One of the missions of the expedition was to place a bronze memorial at Cape Sabine from the National Geographic Society to the Greely Expedition that perished there from starvation and exposure. The Arctic can be very unforgiving.

The Bowdoin was an auxiliary schooner. That means she had two masts with sails and a diesel engine. With 2000 gallons of fuel she had a motor range of 4000 miles. This was claimed to be the longest range of any ship of the day. She of course had sails as the

prime method of travel. She was 88 feet long and 23 feet wide. There was a total crew of seven. She sailed on June 23, 1923 from Wiscasset, Maine north into the sun.

This was not the first time such a radio expedition had been attempted, but none before had been successful. There was a feeling that this time it would be different. And it was. Radio had, and still does, have this habit of throwing a curve ball. With the improvement in radio performance of CW over spark and the other improvements in equipment it was felt by many in the amateur community that WNP would not have trouble working back into the US. It was pointed out that the west coast stations should take heart, as they were not much farther away than the stations on the east coast. WNP would be about 2500 miles north of New York City. After all this range was worked quite often during the winter nights. And the nights where WNP was going to be are six months long. But not in August.

The Bowdoin arrived at Etah, Greenland on August 8th. At this time of the year there was still 24 hours of sunshine at this high latitude. On the trip up the Bowdoin had made numerous stops along the way to make scientific observation, replenish fuel and water and pick up an addition crewmember that would also serve as translator. During the trip they had managed to stay in contact but as they got farther north and more into the continuous daylight signals were getting poorer. As August progressed and the sun started dipping closer to the northern horizon signals started to appear during the short period of near sunset each day. Due to ice conditions they were unable to make it to Cape Sabine or Flagler Fiord and chose Refuge Harbor to winter at. They arrived there on August 17th. By this time received signals were getting steadily better each night as the sun was getting closer to the northern horizon. Most signals heard were from west of the Mississippi. This was a condition that continued for the whole time they were at Refuge Harbor. It would not be until they were back to southern Greenland on the way home that they could hear or work many east coast stations again. On the way north they had talked to many local maritime radio operators who told them they would never work back into the states on 200 meters. Well the local experts were wrong. But it wasn't easy either. In late August there was a brief QSO with 1ANA one of the few east coast stations heard and worked from northern Greenland. Many stations were being heard, some with very strong signals, but no one seemed to be hearing WNP. On Sept. 8 7DJ of Bremerton, Washington was raised and they tried for over an hour but could only exchange "All's Well". Then WNP was called by 9BP of Prince Rupert, BC, Canada. This

was Jack Barnsley and he would be a regular contact, handling over half of the traffic passed to and from WNP during their stay in the Arctic. Often he was the only station WNP could raise and even that was not a sure thing. Of the total of 16,000 words cleared through WNP during the expedition, 8,000 were passed through 9BP, and of the 13,000 received, 9000 were also from 9BP. With the exception of the 7DJ contact, 9BP was the only station worked during Sept.

October was not much better. Besides 9BP, WNP worked 7AHB Alaska, 7DC, and 9EBT. Although Mix was on daily and hearing many stations weeks would pass without a contact. But November would be much better. 9BP handled most of the traffic, but several other Canadian stations were worked and then on the 16th a CQ was answered by 6CEU in Hawaii. This low power station had been heard quite well on many previous occasions but it was exciting for both to work such a path. Especially when the Eastern US might as well have been on the moon. On the 26th of November a distance speed record for a two-way message relay was set when 1HX sent a message to 6XAD who relayed to WNP. The answer was back at 1HX in five minutes and six seconds. Another first was a four country relay from (F)8AB in Niece France, to (U)1XAM, to (U)1HX to (U)6XAD to (C)9BP Prince Rupert BC, and finally to WNP Refuge Harbor, Greenland. Amateur radio had just spanned the Atlantic and was already in the international traffic business. Things were in deed moving rapidly in this hobby.

Conditions in December were not as good as November and January was not much better. In December a condition that Mix called a "QRN storm" started occurring. This was a white noise condition that was present on all wavelengths. Some times lasting for a few hours and sometimes for days. Many times it was so intense that only the strongest signals could be copied through it. Mix seemed to feel it might have been related to the winds driving snow across the frozen harbor. Anyway the condition persisted until spring. The sun returned in February and with it a steady decrease in signal levels. 9BP continued to be the gateway station although several other 7th call area stations were contacted in February. Some were running rather low power. A final contact with 6CEU in Hawaii was made on February 19. The sun was rising rapidly in the sky and during March only one contact was made on the 3rd with Canadian 4HH. The next contact was not made until April 14th, and it was the last from Refuge Harbor. It was with 7DJ who had been the first contact back in September. Radio watch was maintained until mid May but it was discontinued then to conserve fuel for the generators. There

would be no contact with the outside world again until they were on their journey home and off the coast of southern Greenland.

The Bowdoin had been locked in the ice from late September 1923 to June of 1924. This is over eight months. During the stay at Refuge Harbor WNP had only been in contact with 35 stations but many more than once. Especially 9BP. This has to have been a disappointment, but the experts had said that they would not work any. So the amateurs had proven the experts wrong again. There are some interesting observations that I think can be drawn from this in retrospect. It pointed out the difficulty of propagation in the high latitudes. Although one of the missions of the expedition was the observation of the Aurora, they never detected any correlation between the Aurora and radio propagation although it is well known today. Mix in his article on the expedition in November 1924 QST, where I obtained much of this material, stated that they observed little Aurora activity at Refuge Harbor and it did not effect either the short or long wave radio transmissions. We know now that they were well above the Aurora circle. They were only some 500 miles from the magnetic pole.<sup>1</sup> The concentration of stations worked along the west coast in an interesting thing. Mix comments on it several times but does not offer any explanation. Whether it is some characteristic of the propagation from this latitude or if it was due to local terrain is not clear. Refuge Harbor is surrounded by high land extending to 1400 feet above sea level. I expect if Mix had suspected it at all he would have mentioned it, but the knowledge of radio propagation was such that he might not have thought it important. Hawaii was contacted several times with good signals and yet only one first area and one second area station was contacted in eight months. A quick look at the distribution of calls worked points this out. The call areas in 1923 were a bit different. The zero call area did not exist till after W.W.II. So the 9th area included what is now the zero area. The seventh call area was smaller and the sixth bigger including Nevada, Arizona, Utah, and Hawaii. WNP worked four 6th area stations, including Hawaii, thirteen 7th area stations, one 8th area station, and seven 9th area stations. A 3rd, 4th or 5th area station was not worked. Eight Canadian stations were contacted half being in the 4th Canadian call area. Canadian 9BP was the main path of communications with northern Greenland which was one of those curve balls that Radio throws.

By today's standards of tens of thousands of QSOs for a week's effort on some remote rock in the ocean, this first DXpedition by amateur radio may seem insignificant, but it was a first. The mission was more one of providing communications and scientific dis-

covery. The newspaper dispatches from Dr. MacMillian to a chain of seventy major newspapers across the country filed via amateur radio had a side benefit of good public relations for the hobby. And probably inspired many people to an interest in amateur radio. Probably not unlike another expedition some twenty plus years later who's amateur radio reports brought to the attention of a young boy the magic of radio as he followed the progress of a raft floating westward across the South Pacific. Maybe some day I'll tell that story.

Till next time, 73 Bob W1XP

**October Board Meeting in Brief**

The Board met October 9<sup>th</sup> at the KD1LE QTH. Les discussed upgrades to the web page. John Kelly was granted honorary membership for an additional year. The Board is still looking for two more speakers for the November meeting. Ralph presented the Treasurers report that is later in the newsletter. The Board instructed the Secretary to draft a letter thanking Ron W1PLW for organizing the Grotonfest booth. The President appointed and the Board approved the appointment of Den KD2S as Emergency Coordinator for NVARC. Stan reported on the Technician License class that started this week. There are eight students enrolled. He would like to have some members take a future section of the course material and do a presentation or demo.

**Rotary Rail Trail Charity Walk**

NVARC provided communications along the Rail Trail for the 2<sup>nd</sup> annual Groton-Pepperell Rotary Rail Trail Charity Walk. That must be the GPR^2TCW which is still a mouthful.



John KB1HDO and Bob W1XP getting ready at the Groton registration booth. Bob staffed the start while John patrolled from there to Common St.



Bob AB1CV monitored the Common St area.



Above Earl WR1Y and below Larry KB1ESR monitored the walkers in the area of Sand Hill Rd.





Courtesy KD1SM

Stan KD1LE, Ken K1KEY (above), and Ralph patrolled from Sandhill Rd to downtown Pepperell.



Courtesy KD1SM

Dave N1MNX and Cheryl from the Rotary staffed the finish of the walk. Knowing where the last walkers were allowed a very clean wrap up. Thanks to everyone who helped out. Stan

## Wide Band Folded Dipole Comparison

By Stan KD1LE

Everyone can appreciate the problem of getting resonant antennas to cover one of the lower Amateur bands with a reasonable SWR. Due to my participation in Navy-Marine Corps MARS (Military Affiliate Radio Service) my problem is increased because MARS uses assigned frequencies outside the Amateur bands and instead of being a band of frequencies they may be spread across the entire gap between our Amateur bands. Finding suitable H.F. antennas with wide bandwidths or having enough individual antennas to cover the spectrum piece by piece with good efficiency is a challenge.

The last few years there has been interest in what are commonly called Wide Band Folded Dipoles (WBFD's) or Terminated Folded Dipoles (TFD's). The names may not be used consistently so the antenna I am describing is a dipole of some length whose ends are folded back on itself (using spreaders) to a point near the balun and feedpoint. A "terminating resistor" connects the ends. The terminating resistors are typically in the 600 to 800 ohm range with the corresponding baluns in the 12:1 to 16:1 range. Several companies manufacture these antennas and there are articles in the ARRL Handbook and elsewhere.

These antennas have several claimed advantages. Most important is that without a tuner they have a relatively low SWR over their entire operating range. Second, since they are folded they are much shorter overall than a half wave dipole. A typical 2-30 MHz WBFD is about 90 feet long as compared to a dipole for 160 meters that is about 250 feet long. The question of course is how do they perform? Since the length of an antenna is of critical importance to people with limited space the first discussion is a comparison between a 90 foot WBFD and a 90 foot open wire fed short dipole (OWFD) with a tuner. So one of the bounds of the experiment is overall length.

### Comparing an open wire fed dipole (OWFD) to a Wide Band Folded Dipole (WBFD)

Most of the data presented here was taken from two articles by L.B. Cebik W4RNL who is the author of the ARRL Antenna Modeling Course. They can be viewed in their entirety at <http://www.cebik.com/wbfd.html> and <http://cebik.com/t2fd.html>.

### Test conditions for the following comparison

An OWFD and WBFD of equal overall length (90 ft) and a design frequency range of 2-30 MHz. This means an OWFD with 90 feet of wire fed with open wire feedline to a tuner and a WBFD with about 180 feet of wire.

### Problems common to both antennas

The VSWR varies cyclically in relation to the antennas length vs. the frequency in wavelengths.

Both antennas have the problem that as the frequency increases and the antenna becomes greater than 1.25 wavelengths they develop a lobed pattern. At 25 MHz there are eight lobes. The lobes have nulls that can be 20-30 dB deep so coverage will vary considerably depending on the location of the other station when used on the higher frequencies.

Height above ground affects the antenna performance separate from the other issues and is common to both antennas

### **OWFD problems/features**

For all-band/wide-band use it needs to be fed with ladder line or dual coax from a tuner.

Has greater than 5 dB more gain than WBFD over the entire frequency range

### **WBFD problems/features**

Wire spacing in WBFD has little effect comparing 8 and 16 inch spacing.

The SWR of a typical WBFD at a height of 20 feet falls between 1.2 to 2.2. Lower antennas may have higher SWR's. These values should be within the tuning range of a typical modern transceiver tuner and are certainly within the range of any external manual tuner.

The typical power resistor used is rated at 100 or more watts and would theoretically be suitable for 1KW intermittent amateur service. The combination of running Continuous modes like AMTOR or Baudot and operating at low HF frequencies require transmitting less power. We have come to equate low SWR with high power transfer efficiency and make the leap to the assumption that the antenna is efficient. While the "matching resistor" satisfies the radio as far as SWR it does nothing to change the fact that there are very high SWR's on the antenna and therefore high currents and voltages. This means at certain frequencies and especially at low HF frequencies a large percentage of the power is consumed in the resistor and can be catastrophic. The terminating resistor losses in a WBFD antenna are from nearly 50% to 90% depending on the SWR. This is unlike a traditional tuner antenna combination where the tuner satisfies the transmitter SWR requirements and the losses on the antenna side are those of the wire, which are very low, so most of the power is radiated.

WBFD antennas have a knee in the gain curve. For the 90 ft model the gain falls off dramatically below 7 MHz. Making the antenna longer can move the knee in the curve lower in frequency. This increases the problem listed under "both antennas" of lobes in the pattern at higher frequencies.

Below are some values of the gain difference between the 90 foot Open Wire Fed Dipole (OWFD) and the WBFD taken from the curves in Cebik's articles.

5 MHZ WBFD 7 dB below the OWFD  
4 MHZ WBFD 10 dB below the OWFD  
3 MHZ WBFD 15 dB below the OWFD  
2 MHZ WBFD 24 dB below the OWFD

These are significant values. Unless you always have plenty of signal to spare with the stations you communicate with this is a real problem. To make up for the lack of efficiency you must run more power which reduces battery life, use station to station relays, or suffer lower throughput due to repeats.

### **My on-the-air receive comparisons**

Since I am most interested in the lower HF frequencies and operate there daily I observed received signal strength readings from stations across Southern New England nightly for several weeks. The measurements were done at a frequency near 2 MHz. I used my full length half wave 160 meter dipole as the reference point listening first there, then on the 90 foot WBFD, and then on my full length half wave 80 meter dipole antenna. The received signals from the WBFD were down five S units for each station. Using my 80 meter dipole the signals were down four S units when compared to the 160 meter dipole. In terms of SWR the 160 meter dipole and the WBFD are matched to the receiver. The 80 dipole is not and inserting a matching circuit between it in the receiver would recover much of the lost signal making it several S units better than the WBFD.

### **In Conclusion**

If you want to be on the low bands, and circumstances require you to use the minimum length antenna, an open wire fed dipole antenna and tuner will give you better performance than a WBFD. If frequency hopping is required and a tuner won't do the job a WBFD may work for you with the understanding that the performance is much poorer. This is less of a problem for casual communication because if you don't hear anything you just come back another time or day. If regular or emergency communications are your goal then the open wire fed dipole or full-length dipoles are preferred and you make allowances for available space by bending the dipoles as needed.

I hope this comparison points out the trade-offs so you can make an informed decision when selecting an antenna for the type of operating you do.

Stan KD1LE

**Other Public Service Activities**

NVARC member's participation in other public service activities in the past month.

Stan KD1LE attended a Military Affiliated Radio System (MARS) conference at Lake George NY September 4-6th.

Ralph KD1SM and Stan KD1LE helped support the Ride for Hunger September 14<sup>th</sup>, in Framingham. This event is like the Walk for Hunger but on wheels.

Stan KD1LE supported the Jimmy Fund Marathon.

### \$October Treasurers Report\$

Income for September was \$95 in membership dues, \$35 from PowerPole connector sales, and \$8 from mug sales. Expenses were \$14.80 for newsletter postage, \$25 for speaker honorarium for September, and \$255 for our liability insurance premium leaving a net expense of \$156.80 for the month.

Current balances:

General fund	\$4465.90
Community fund	\$1842.55

Welcome to new member Dick Parr, who is taking our licensing class to re-gain his Amateur license that had lapsed. Welcome back to Jon Kinney N1JGA who has re-joined the Club.

Can we persuade you to support ARRL and its educational activities on behalf of Amateur Radio? Membership in ARRL is a way to show appreciation for the many outreach programs. If you are not yet an ARRL Member and wish to become one, consider letting NVARC handle the paperwork for you. ARRL rebates a portion of new membership dues back to the Club. There is no longer an ARRL rebate for ordinary membership renewals handled through the Club.

73, Ralph KD1SM

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Meetings are held on the 3rd Thursday of the month -  
7:30 p.m. - Pepperell Community Ctr. Talk-in 146.490  
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442.90 + 100Hz Repeater

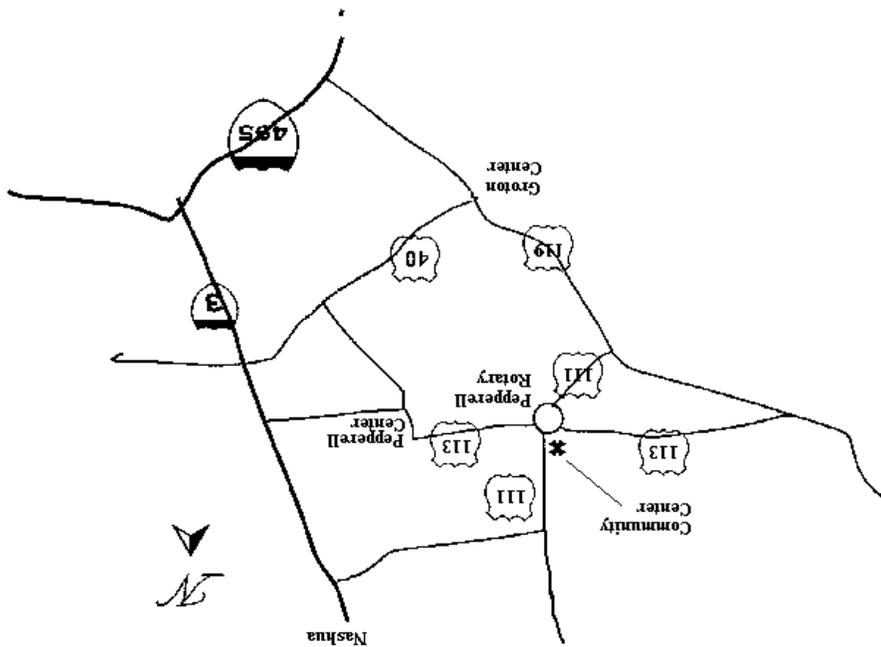
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This newsletter is published monthly. Submissions, corrections and inquiries should be directed to the newsletter editor. Articles and graphics in most IBM-PC formats are OK. You can send items to

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