



The Hamilton Amateur

The Hamilton Amateur Radio Club Newsletter – 76 Years of Amateur Radio 1932-2008

The Hamilton Amateur Radio Club
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 Est. 1932 Inc. 1956
<http://www.hamiltonarc.ca/>

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Next Meeting

by President David
 Bruton, VE3DWJ

Our next monthly meeting will take place on Wednesday April 15th, as early in the month as a meeting can be.



Our guest speaker will be George Gorsline, VE3YV. George lives in downtown Toronto and his specialty is chasing DX. Operating successfully from a small lot in the city presents its challenges, but over the years George has developed a number of techniques resulting in award winning performance. George has a number of suggestions covering all aspects of ham radio from eliminating noise to gaining an edge is pile-ups. His experience should be invaluable to all hams whatever your branch of the hobby. George's illustrated talk has been well received in other clubs and we are excited to have him present to our group on the April 15th. We hope you can join us then.

even in-directly. My name is Jacques Gauthier VE3WBT, and I am serving HARC as your 2009 Field Day Co-ordinator. My e-mail is <ve3wbt@hamiltonarc.ca>

As you're aware Field Day is an "Emergency Preparedness" day, where Hams exercise their abilities of using antennas, battery packs, generators etc, to get on the air and make contacts local and worldwide. If you have ever worked Field Day, you can understand the rush of excitement one gets.

Over the last few years we had a great turnout with participants and visitors alike. This year I would like to see our club have the best Field Day ever. You can help make this happen by giving serious thought of getting involved. Your involvement can be as a band captain or assistant by sharing time on-air. You can also get involved, by visiting our site and placing a call or two. The more the better, as we can accumulate points in many ways. Thus, any assistance you can provide will be helping your club!

If you're thinking of becoming a band captain please forward an e-mail to me with your name and call sign along with the band and mode of operation you would like to use. If you have someone that will assist you include this with the e-mail as well. First come first served. You can find my e-mail address on the news letter, looking forward to hearing from you.

73's
 Jack, VE3WBT

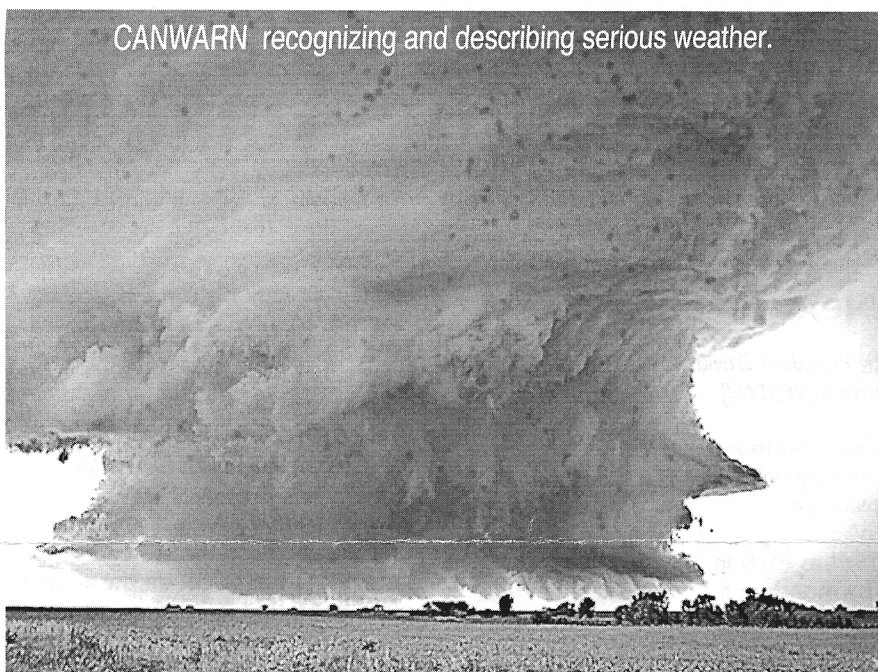
Field Day

by Jacques Gauthier
 VE3WBT

Well, Field Day is approaching, and this year, we as a club can participate directly and



Club meetings – 3rd Wednesday each month – 7:30 pm (except July and August) at Hamilton District Christian High School, 92 Glancaster Road, Ancaster, L9G 3K9, corner of Rymal Road (Hwy. #53) and Glancaster Road. Parking on location. Complimentary refreshments.



Spring 2009 CANWARN Training

by Geoff Coulson of Environment
Canada

Folks...once again I find myself writing this note and wondering what has happened to the last few months. The last thing I seem to be able to remember is doing media interviews about what kind of winter we were going to have and now as I look at the calendar I realize that Spring's official arrival is only a little over a week away.

We have already had some thunderstorms roll through Southern Ontario this month as a reminder of what will be in store for us, in a more frequent sense, starting in April. This brings me around to the topic of this note...severe thunderstorms, tornadoes and the spring 2009 CANWARN training schedule.

At this point, I'd like to thank all of the members of CANWARN who provided weather reports either to their local net controller or through our 1-800 toll free reporting line during the summer of 2008. The summers of both 2007 and 2008 did

not really have any major damaging weather events. This has led some in the meteorological community to speculate that we could be in store for a busy summer severe weather season in 2009. All the more reason to come out to a CANWARN training session near you if you have never had the opportunity to attend one or haven't managed to come out to one in a few years. That's not to say that I won't enjoy seeing those of you who have come out regularly for the past number of years. As is the case every year, we will endeavour to tweak the presentation to keep it fresh even for those who have taken the training numerous times.

As always, Environment Canada appreciates the work of the CANWARN volunteers. CANWARN continues to be an integral part of our Watch/Warning system during the Spring and Summer...remaining our eyes and ears to let us know what is happening "on the ground".

You and your friends are invited to attend a training session

**Saturday April 18th 9 AM...
Hamilton.. Nash Auditorium,
Wilcox Building, Chedoke
Hospital, Sanatorium Road,
Hamilton**

HARC 2008-2009 Executive

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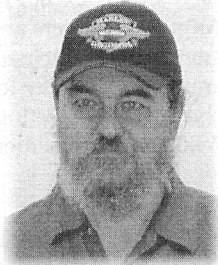
Returning to the Erland Lee Museum

Lorraine also reports the following date for the Erland Lee Museum fundraiser.

Volunteers from the Hamilton Amateur Radio Club will be operating a demonstration station at the Erland Lee Museum on Saturday March 28th, 2009 8 am until noon. This is the Museum's annual fund raising event. A local service club will be serving a pancake sausage and real maple syrup breakfast. Come and join us at the station or drop in for breakfast. Talk to VE3DC on air.

A Product Review - An Experiment - A Lesson Learned

by John Hudak
VE3CXB



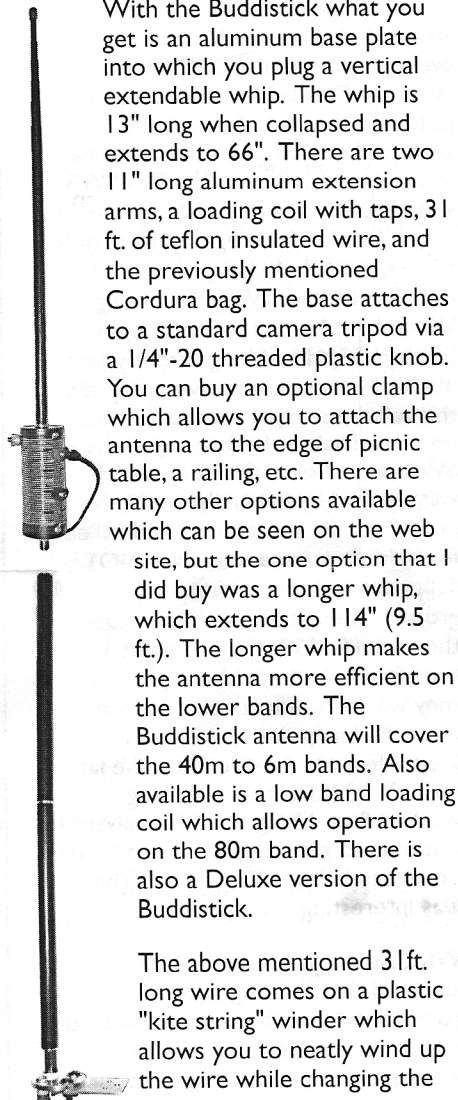
Last year I decided to assemble a portable kit to take with me when we went on a trip. My portable rig is a Yaesu FT-897D transceiver. I chose it because it is a "do everything" rig - it's portable, it covers 160m to 70cm. all modes, and it has a fairly decent general coverage receiver which even includes the FM broadcast band. As I was not planning to operate from a battery supply I purchased the optional internal switching supply for this transceiver. This reduced the number of boxes (external DC supply) and cables I had to pack for a trip. I then had to decide on an antenna. I thought I could get away with a random wire antenna and an antenna tuner, but my first attempt with this setup was less than stellar.

Via ads in QST and on the internet, I came across the Buddistick portable vertical antenna. You may have seen the ads for the Buddipole antenna, which is a portable dipole manufactured by Budd Drummond W3FF

< www.buddipole.com >. The Buddipole and Buddistick are portable HF antenna systems. There's plenty of info on the internet on how to homebrew these antennas. In fact I believe they started out as homebrew antenna projects before W3FF went into business manufacturing them. There's nothing special or revolutionary about them. They are both shortened, coil loaded antenna systems, and with some effort you could cook up workable duplicates of the commercially available versions. The quality of the "made in the USA" components is quite high though, and

the makeup of this antenna system, especially the Buddipole, is like a "Tinkertoy". The various components can be put together into a variety of different configurations. Everything breaks down into a small, easily transportable package, and comes with a really nice Cordura bag.

Why did I go for the vertical Buddistick instead of the dipole? Although the antennas are not overly expensive, they're not cheap either, and I really didn't want to spend the extra money on the dipole system. I was basically buying an antenna "sight unseen" and did not want to put out too much money for something that may or may not work that well. You can check out the prices on their web site and decide for yourselves if they're worth the money or not.



With the Buddistick what you get is an aluminum base plate into which you plug a vertical extendable whip. The whip is 13" long when collapsed and extends to 66". There are two 11" long aluminum extension arms, a loading coil with taps, 31 ft. of teflon insulated wire, and the previously mentioned Cordura bag. The base attaches to a standard camera tripod via a 1/4"-20 threaded plastic knob. You can buy an optional clamp which allows you to attach the antenna to the edge of picnic table, a railing, etc. There are many other options available which can be seen on the web site, but the one option that I did buy was a longer whip, which extends to 114" (9.5 ft.). The longer whip makes the antenna more efficient on the lower bands. The Buddistick antenna will cover the 40m to 6m bands. Also available is a low band loading coil which allows operation on the 80m band. There is also a Deluxe version of the Buddistick.

The above mentioned 31 ft. long wire comes on a plastic "kite string" winder which allows you to neatly wind up the wire while changing the

HARC 2006-2007 Chairs

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Hospitality

Currently an open position seeking volunteers.

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Anita Thomas VA3ANI,
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Emsley Mitchell VE3JAI / VA3QI
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length for the various bands. The purpose of this wire is to act (supposedly) as a "counterpoise". The web site calls it a "radial". I say "supposedly" because, as I found out the hard way, the wire is neither. Basically you clamp the aluminum antenna base to your camera tripod or whatever other mount you want to use, attach the two aluminum extension arms to the base, then attach the loading coil, and lastly attach the whip. The wire is also attached to the base and is extended out to a length of 1/4 wavelength on the band you wish to operate on. You must adjust the tap on the coil for the desired band. Hook up your coax cable and adjust the height of the antenna until the feedpoint is at least about chest height or higher. This "apparently" results in a more or less centre loaded vertical antenna with one radial wire. I will explain my use of the word "apparently" later. No, this is not a "quick set up" antenna, although once you get the hang of it, it goes pretty quickly. I knew this going in but if I wanted "faster" I would have bought one of the screwdriver type antennas, at about 4 to 6 times the cost. Actually I've never used a vertical before so I really didn't want to lay out a lot of money in case I didn't like the vertically polarized experience.

Tuning the antenna consists of adjusting the tap position on the loading coil, the length of the whip, and the length of the wire. The antenna comes with some "starting point" instructions to get you going, and there is additional info on the internet. However you will still have to do some experimentation to get the right settings. On the lower bands you would use the whip extended all the way and adjust the taps on the coil. As you move up in frequency you will get to a point where you can remove the coil altogether and just adjust the length of the whip and the wire to tune the antenna. To tune the antenna without an antenna analyser you're supposed to move the shorting wire up and down the loading coil, and if necessary adjust the length of the whip, until in your receiver you hear a maximum amount of background

noise. Then you adjust the length of the wire until you get close to 1:1 SWR.

Hopefully your rig has some means of reading out SWR. My FT-897D does have an SWR read out but if yours doesn't then you will need an SWR meter. I won't mince words here - it does take some finicking around to get the antenna tuned, but once you've done it a few times it becomes much easier.

I've been trying to write this article for some time now, mostly because this antenna has been baffling me. Something about it's operation didn't make sense and I've been wondering about it since I purchased it. I now have it figured out, so the result is this review.

My first attempt to use the antenna was on a trip up north. I set everything up and since the wire is "supposed" to be a counterpoise I just layed the wire down on the ground. I could not get the antenna to tune up to save my life. The SWR was all over the place and I had RF in the shack. I did manage to make only two contacts before I gave up and just shut it down. Very frustrating. When I got home I was talking to Emsley VE3JAI and he graciously lent me his MFJ antenna analyser. Boy, did this tell the story. I set the antenna up in my backyard. Once again the SWR was all over the place, which was verified by the analyser. At this point I got on the internet and called for help. It turns out you are NOT supposed to lay the wire on the ground. It must be suspended above the ground. With the feedpoint at least 5 feet or more above ground they want the wire to slope down from the feedpoint to a height at least 2 feet above ground on the far end. Once I did this everything worked fine. Using the MFJ analyser I was able to get the SWR down to 1:1 on all bands from 40m to 6m. This was interesting.

Where did I go wrong? Well I assumed that the language was correct and that the wire was indeed a radial or a counterpoise. That's what everyone was calling it. I sure

Important Points

Executive Meetings

HARC Executive committee meets each month, except July and August. Members are invited to attend and participate. The meetings are on the Tuesday following the club General Meeting each month. Ask an executive member for the location.

VE3NCF 146.760 - & 444.075 +

HARC operates VE3NCF repeater, located atop the Niagara Escarpment. It's open for use by all Amateurs. Special features are a privilege of membership.

Nets

HARC "check-in net" is held every Tuesday evening at 7:30 p.m. HARC "swap net" follows at 8 p.m. All contacts are welcome.

Examinations

Amateur radio license examinations are conducted the second Wednesday of each month, except July and August. Contact the voluntary examiners to make an appointment. There will be a fee for each examination.

Membership Information

Club membership, including all privileges, is \$25 per person, per year, Sept 1 to Aug 31. Additional membership, for immediate family living in the same home, is \$1 per person. One newsletter sent to each address.

The Hamilton Amateur

The Hamilton Amateur is published ten times each year (not in July or August). Deadline for article submission is the last Saturday of the month for the next month's issue. Preferred format is .txt file. Articles will be checked for spelling and grammar, but the author is responsible for factual content. E-mail submissions to Editor, John Hudak VE3CXB, <hudakjm@mcmaster.ca>

looked like an elevated radial, but there is only one wire. In fact it is neither a counterpoise or a radial. The wire is a "radiating element". The Buddistick is actually an "L" shaped dipole. By laying the wire on the ground I was capacitively shorting out one of the antenna elements to ground. I did contact the company and suggested they purge the words "radial" and "counterpoise" from their literature, but to date they have not.

Oddly enough the folks at the company did indeed confirm that the wire is an active radiating element and not a ground return element. Go figure.

Just recently on the Buddipole newsgroup there was an article by KE4UYP, who is a bit of an antenna guru, confirming this very fact. He ran some EZNEC (an antenna modelling program) simulations with radiation pattern plots. Now it all makes sense to me. His description of the antenna is a "somewhat bent" 1/2 wave sloper with one element being a wire and the other element a shortened coil loaded whip. He ran some further experiments by trying to add more wires. The result was a drop in gain. If you have more than one wire and you space them out equally around the base then they behave like radials in that any radiation from them cancels out and they in effect cease to become radiating elements. In fact KE4UYP states that most of the radiation comes from the single wire element and not the vertical whip. This also makes sense if one looks at the antenna currents along each element. The antenna does not have an omnidirectional pattern like a vertical but really is more like a sloper with a maximum lobe in the direction of the wire. It is this lobe, and the fact that the wire comes down from the feedpoint at an angle and is not perpendicular to the vertical portion of the antenna, that causes the gain to be higher than that of a vertical antenna.

Once I got the antenna operating properly at home it worked quite well. I was able to make a reasonable

number of contacts, not withstanding poor band conditions and the low sunspot numbers. At this point I had not had another trip to try it out in the field. That opportunity did eventually come this past October when we went up to Muskoka. I made arrangements to try for a QSO with some of the club members on our usual Monday night 20m chit-chat net. As it turned out, that same weekend was the California QSO party. This would give me a good chance to test the antenna. During the contest I worked all sorts of stations. I managed to contact a bunch of California hams on 20m plus additional stations in Texas, Switzerland, Germany and France. This was with 100W out of the Yaesu. I wasn't breaking any pileups but I was making contacts. In fact the determining factor seemed to be propagation more than the antenna. Most of the time I was getting 55 to 59 reports. The Buddistick seemed to be working quite nicely for DX. However, I couldn't hear anyone at home. I called but nobody heard me. I pretty much expected this to happen as I figured that by the time night rolled around the 20m band had gone long. Just for a few seconds though I could hear Rick VE3BK with his booming voice calling me faintly out of the ether. I called him back, but with no luck. It was only later on after I returned home that I learned that Rick VE3BK, Emsley, VE3JAI and Mardy VE3QEE were listening for and calling me. During those few seconds when I did hear Rick he had turned his 3 element beam in my direction and was pumping out close to a full gallon in my direction. With all that I just barely heard him. In hindsight it makes sense. It just proved the point that at night the lower bands would have been better for my attempt to contact the folks at home instead of 20m. Next trip I'll try the lower bands.

So, there you have a report of my experiment on 20m. and my first real test of the Buddistick antenna in a portable situation. Since then I've also managed to work stations on all bands from 40m to 6m. All in all I've been very pleased with the

performance of the Buddistick so far. Mardy VE3QEE has purchased the Buddipole horizontal dipole version of the antenna so he may have some comments on it's operation. In fact with the Buddipole you can configure it as a Buddistick if desired. I did read of some comparison tests that seem to indicate the Buddistick works better for DX, but this would make sense if there is a vertically polarized component to the radiated field which results in a lower takeoff angle. Low takeoff angles are better for long haul DX. It just goes to show that you can work portable and make some decent contacts with a relatively simple antenna system. My thanks to VE3BK, VE3JAI, and VE3QEE for their help.

Did You Know Bill Crawford ?

Recently, HARC received the following request for information. If you can help please e-mail Kevin Leahy directly.

Kevin Leahy wrote:

"I am the grandson of a founding father of your club, Bill Crawford.

I am building our family tree information and require help in finding Bills working years info, do you have access to the clubs records?"

Kevin Leahy

<kleahy13@cogeco.ca>

Mardy VE3QEE, replied:

"Hi Kevin, I joined the Hamilton Amateur Radio Club in 1993 and cannot give any first hand information before that time. However, for a lot of years, issues of The Hamilton Amateur, our monthly newsletter, have been added to a collection in the Special Collections Department of the Hamilton Public Library main branch. If you go down there I am sure the librarian would be happy to show you the collection and you could probably get some valuable information from that source.

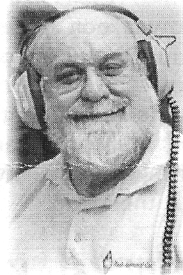
All the early club records were burned in a fire that destroyed the Moose Hall a number of years ago so the monthly newsletters would be the only other source of surviving

information that I could suggest. I will print your request and this response in the club newsletter this month in case any members with information might get in contact with you.

Good luck in your search.
Mardy Eedson, VE3QEE, current newsletter editor."

Contest Corner

by Rick Danby
VE3BK



Mark your calendars as there's just a couple weeks till the 2009 running of the Ontario QSO Party. This year the contest runs on the third full weekend of April - 1800Z April 18 to 0500Z April 19, and 1200Z to 1800Z April 19.

Following the Record level of participation last year 2009 should be just as much fun if not more. Now is the time to start thinking about mobile and portable operations as well as strategies for this year's contest.

The complete 2009 rules and awards can be found on the Contest Club Ontario website at <http://cco.ve3xd.com/oqp/index.htm> To plan your operating schedule [and let the rest of us know] you can check the "who's going to be on" page at <http://cco.ve3xd.com/oqp/who.htm> the page is updated as soon as new stations announce their operating plans and will be updated right up to the day of the contest.

In 2008 there were 35 new records entered into the database! If you're looking to set a new State, Province, Section or DX record [or break an old one] check the current records page at <http://cco.ve3xd.com/oqp/records.pdf>

This contest is our "home" contest. It is the ONTARIO QSO contest. This contest also is a daytime contest. Operators can take time off to sleep.

Reporting on the Last Contest

Here is a summary report on the CQ 160-Meter W.W. Contest last month:

CALL: VE3DC
PROVINCE ONTARIO
CLASS: Multioperator
759 QSOs. 3588 QSO points x 62 Multipliers (54 SECTIONS 8 COUNTRIES)
= 222456 Claimed score

Station Description: Icom 751A, Ameritron AL-572, Palstar AT4K Tuner
Antenna(s): Full size horizontal Delta Loop for 160m, Windom cut for 160m

Operators: VA3DJ VE3BK VE3RYI VE3GCP VE3EEZ VE3OCD
Visitors: VE3DCU and VA3TVW

Remarks: This contest went very well. The band was very busy and hard to find a spot to call CQ, but we did and the points started to rack up. This is one of the busiest contests making it a challenge to find a spot to call CQ. Calling CQ we gave VP2E Anquilla, ZF2AM Caymen Island, C6ANM Bahamas, XE2TZP and XE2TH in Mexico plus KP4KE in Puerto Rico contacts. Some other contacts were HI3TEJ Dominica Republic, KV4FZ Virgin Islands, and CM6RCR Cuba. We mostly worked North America with a great participation this year. We had fun working so many people. Thanks to all that worked us making this another successful contest.

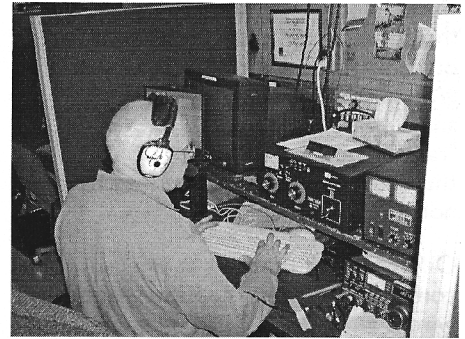
Club competition: Members of the Contest Club Ontario.

This is to certify that in this contest I have operated my transmitter within the limitations of my license and have observed fully the rules and regulations of the contest.
R.W.Danby Call: VE3BK

MULTIPLIER LIST:

CT MA ME NH RI VT NY
NJ DC DE MD PA AL FL
GA KY NC SC TN VA AR
LA MS NM OK TX CA AZ

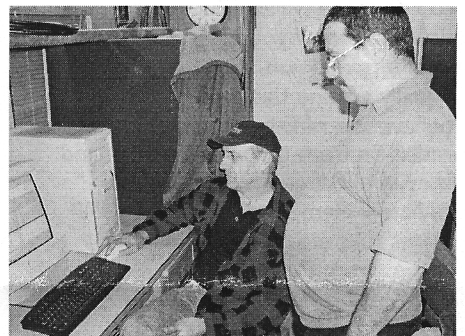
Pictures from the CQ 160 Meter World Wide Phone Contest courtesy Rick VE3BK



Fred, VE3GCP



Joe, VE3OCD



Jim, VE3EEZ with Mark, VE3RYI looking on

NV OR UT WA WY MI OH
WV IL IN WI CO IA KS
MN MO ND NE NB NS PE
QC ON SK AB BC

DX:

C6 CM HI KP2 KP4 VP2E
XE ZF

Join the testers for a couple of hours or for the whole weekend. Give Rick a call. First-timers welcome.

Minutes Of March 18th, 2009

By secretary Ron
Ouwehand VE3OUW.



David Bruton introduced our guest speaker David Wilson, VE3BBN. David did a presentation on Reflections. This was all about feed line, antenna, and rig SWR and how it affects our hobby. His talk was based on the book written by Walter Maxwell W2DU by the same title. David did a wonderful job debunking the myths surrounding SWR. A good presentation indeed!

A motion was put forward to accept the minutes of the last general meeting by David Bruton and seconded by John Hudak. The motion was carried.

A motion was put forward again by David Bruton to accept the treasures report as presented by Fred Robinson. Mike Krebs seconded this. The motion was carried.

Contesting – Rick Danby

April 18 is the Ontario QSO Party. Last year we came in second in Ontario

CQ World Wide CW contest is on March 28 & 29. This is a 48-hour contest.

Rick told us about www.callsign.ca. This is a database of all Canadian amateurs.

Flea Market – Fred Robinson

The new location for the 2009 flea market will be at the New Ancaster Fair Grounds. This is published in our bulletin and Anita has put it on the club web site. Street addresses and GPS coordinates are both on the web site. Fred has asked that we all tell everyone about the move to the new location this coming October.

Past President – Lorraine Macpherson

The Erland Lee Museum event will be held on March 28 starting at 8 am. Our club sets up a radio station at this open house / breakfast.

Can-Warn training will be held again this year at the Nash Auditorium on April 18, at 9 am.

Anyone interested in ARES is urged to contact Jerry at VE3@ares-ham.ca for training.

RAC has asked the club for a volunteer to help with the QSL system.

Awards – Casey VanBroekhoven

Casey announced there would be no Order of Merit this year since no one was nominated.

May will be home brew month and all members are urged to submit their projects related to the hobby.

Health & Welfare – Mary Urbanski

A get well card was sent to Kevin's mother who was sick. No further news.

Repeater – John Vandenberg

John announced that he was still in the process of installing the new controller.

Membership – Sherry Goeller

Sherry told us there were 65 primary members and 9 family members.

Field Day – Jack Gauthier

An announcement will be made elsewhere in this newsletter about the upcoming event. Jack will have a meeting with the RGB on March 23.

Mike Krebs made a motion to adjourn and Ron Collis seconded that. Adjournment 9:20 P.M.

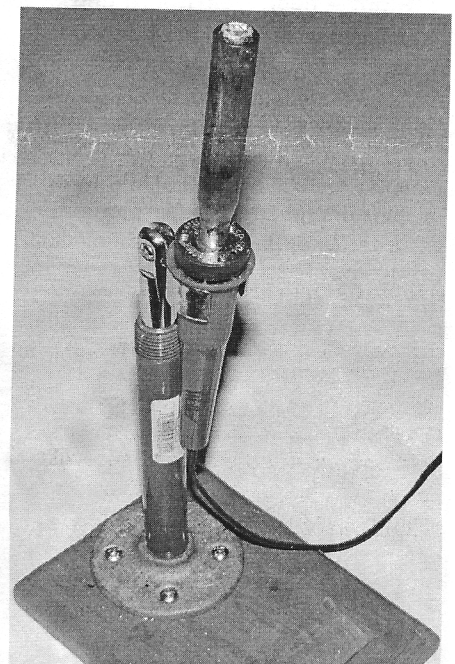
Mini-Solder Pot

idea passed along by Mardy VE3QEE

The other day I came across a PDF (portable document file) on the internet called a Mini-Solder Pot. In the article Ken LoCasale, WA4MNT

describes a solder pot made by drilling a hole in the bit of a surplus soldering iron, and mounting the iron upright. With the melted solder he is able to burn off the insulation and tin the leads of ferrite toroids in one dipping operation. I was inspired by the article and pictures of it so I decided to try and make one. At home I had a surplus 80 watt Weller iron with a bit that had been eroded through. I cut off the tip and drilled a hole into the stem which turned out to be copper. I filled the recess in the stem with Koki lead-free solder. The mini-solder pot worked great. I was able to solder 68 strand Super-Fex wire in the twinkling of an eye. It helps if you put a little flux paste on the wire before it is dipped in solder. When you unplug the iron the solder solidifies until you need to use the mini-pot again. When slag forms on the surface of the hot solder scrape it off and top up the pot with fresh solder.

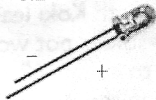
Warning. If you are going to try this technique take the precaution of working on a metal cookie tray or some similar surface. If you were to accidentally upset the mini-pot full of hot solder on a flammable surface you run the risk of starting a fire or giving yourself serious burns. Quantities of spilled hot solder will stay hot for a long time.



Nuts and Bolts of Ham Radio: how to replace incandescent bulbs in older equipment with light emitting diodes.

by Rick Danby, VE3BK

3.2 vdc LED



This suggestion came by the internet. It seems like a good idea because the old style bulbs produced a lot of heat and were subject to burning out. Here is a way to replace those old bulbs with a long lasting LED. Use a clear LED and add a 680 ohm resistor in series with the positive lead of the led. Wire the led and resistor to the leads feeding the 12V lamp, making sure you keep the polarity correct. If you have equipment with no indicator lights, like a power supply, you can use the same method to install a LED indicator light to show when the unit is turned on. Just wire the LED and resistor combination in parallel with the 12V supply.

Right - near Wentworth and Concession early January 2009. Murphy again?

Below - Frank VA3FWL and John VE3DVV manning station VA3HWM at the Warplane Heritage Museum

	Local 12 hour time	Local 24 hour time	UTC Winter EST	UTC Summer DST
midnight	12:00 AM	0:00	5:00	4:00
	1:00 AM	1:00	6:00	5:00
	2:00 AM	2:00	7:00	6:00
	3:00 AM	3:00	8:00	7:00
	4:00 AM	4:00	9:00	8:00
	5:00 AM	5:00	10:00	9:00
	6:00 AM	6:00	11:00	10:00
	7:00 AM	7:00	12:00	11:00
	8:00 AM	8:00	13:00	12:00
	9:00 AM	9:00	14:00	13:00
	10:00 AM	10:00	15:00	14:00
	11:00 AM	11:00	16:00	15:00
noon	12:00 PM	12:00	17:00	16:00
	1:00 PM	13:00	18:00	17:00
	2:00 PM	14:00	19:00	18:00
	3:00 PM	15:00	20:00	19:00
	4:00 PM	16:00	21:00	20:00
	5:00 PM	17:00	22:00	21:00
	6:00 PM	18:00	23:00	22:00
	7:00 PM	19:00	0:00	23:00
	8:00 PM	20:00	1:00	0:00
	9:00 PM	21:00	2:00	1:00
	10:00 PM	22:00	3:00	2:00
	11:00 PM	23:00	4:00	3:00
midnight	12:00 AM	0:00	5:00	4:00

