Natural Radio

News, Comments and Letters About Natural Radio

June 2006

Travels, Ancient Mariners, and SDR – This has been a traveling month. I logged almost 4000 miles in the van, driving with my family to the south and then alone to Dayton for my annual Hamvention trip.

The journey started in mid April with a trip to Florida for a wedding. Through the generosity of one of my wife's business associates we were fortunate enough to have the use of a house on one of the barrier islands south of Fort Myers. We were also fortunate that all three sons were able to get off of work and school to be with us on vacation.

It is a 20 minute trip by boat to the island, there is no phone service other than cellular, electricity is provided by a diesel generator, and satellite Internet service was added recently. I had visions of sitting on a deck overlooking the Gulf of Mexico, sipping a margarita and being able to research and write my article without the usual pressure of ringing telephones, jobs that needed to be done, and all the other daily interruptions.

Unfortunately, when we got to the island and asked about the Internet connection, I was shown the ends of two coaxial cables which needed a bit of interfacing to become an Ethernet connection. After a bit of questioning I learned that there had been a break-in, and the computer had been stolen a few weeks before and obviously, to me at least, the box that contained the Earth Station end of the satellite link. So, I would be without an Internet connection for a week. I managed to get a cellular call through to information, got Bill's phone number in Pennsylvania, and left a message that there would be no article for the month. Fortunately, my view of the Gulf and the margaritas were not dependent on an Internet connection.

My dependence on the Internet for most of the things I do is amazing. I could easily give up radio and television and wearing a watch, but I am lost without the Internet. Even so, I was easily distracted by the natural beauty and wonder of the sea and the wildlife on the island including iguanas, armadillos, turtles and a variety of crabs – some edible and quite tasty.

Being on the beach at night with a clear sky and just enough starlight and atmospheric reflection to make the whitecaps visible can quickly release on from the bonds of the present time. Sitting there on the shore with only the ocean and stars, *present time* had little meaning. I could be sitting there in *any* time. The ghost ships sailing on the Gulf of Mexico that night were piloted by mariners who sailed these unknown and uncharted seas hundreds of years ago with no Loran, Omega, GPS or beacons of any kind.

It is said that the Chinese uncovered the magic of the compass in the 5th century and that the Finns and the Lapps made use of a floating needle for navigation on their Baltic wanderings around the time of the first millennium – the Vikings probably used it shortly after that. But it wouldn't be until some five centuries later that the true nature of geomagnetism would be grappled with. It really wasn't the lodestar, Polaris, exerting control over the floating needle, but the earth itself.

In that milieu, around 1600, William Gilbert published his masterpiece, *De Magnete*, and thus began the science of terrestrial magnetism. Many hold that this work was truly the beginning of modern science. This was also a great period of exploration as the sea captains went out to explore and map their newly discovered spherical world, keeping meticulous records of their observations and compass readings.

Let's fast forward to the present, but we'll come back to these sea captains with their compasses and logbooks a bit later.

A Reversing of the Poles – For years now, there has been much speculation that the earth's magnetic field is in the process of reversing. Magnetic records in rocks have led scientists to believe that this occurs every 300,000 years or so, an eternity compared to the 22 year cycle of pole reversals on the sun. Anyway, the earth's magnetic poles haven't reversed in 780,000 years, so we are long overdue.

This reversal doesn't happen in the style of Hollywood disaster movies with cataclysmic results and all magnetic objects on the earth becoming projectiles. It occurs over several thousand years with the field slowly declining and passing through zero and then increasing in the other direction. While the results might not be apocalyptic, we would lose the protection that the magnetic field provides against the high energy particles that bombard us after coronal mass ejections. There would definitely be some great auroras at all latitudes.

Getting a historical picture of how the earth's magnetic field varies over time has been difficult. Prior to 1840, scientists depended on magnetic fields trapped in rocks and other archaeological formations. Molecules of iron and other magnetic materials within the earth or pottery are frozen in line with the earth's magnetic field when the item is heated and then cooled. These frozen fields are a permanent record of field direction and strength and were the method used to determine that the earth's magnetic poles periodically switch polarity.

Recent scientific studies, however, cast some doubts on the idea that the overall field is declining thanks to the sailing men of the past and their clipper ships. David Gubbins, a researcher from University of Leeds in the United Kingdom began studying magnetic data from old ship voyages in the 1980's and used that data to create a model of the earth's magnetic field that went back over 250 years further than the current records that began in the 1840's.

Ship captains kept regular records of the magnetic data from their compasses – their lives depended on it. Compasses were the high-tech instruments of those times and one can only surmise that they took as much pleasure in that ever-north-pointing needle as we do in our GPS receivers and laptop computers. They would determine the direction of true north by observing the stars with their navigational instruments, note the variation to the nearest degree, and then calibrate the compasses to that measurement. Sometimes they measured the steepness at which the magnetic lines entered the earth's surface. All of these measurements were logged daily in the ship's log.

Using the old sailing ships' logbooks, which recorded magnetic field directions and combining it with a global model of directions from geological data, Gubbins and his PhD students produced 250 years worth of measurement data. They started with easily obtainable data like those in the logs of famed English sailor and South Sea explorer, Captain James Cook. Then they began searching various archives in Europe and found some 50,000 'lost' 18th century measurements in the East India Company Archives in London.

The scientists demonstrated that the overall strength of the earth's magnetic field had hardly varied at all between the years of 1590 and 1840. Since the end of that period, the field has declined at a rate of roughly 5% per 100 years.

So what about the decline in the strength of the earth's field that so many others have measured and the implication that we are heading toward a polar reversal?

We often represent the Earth's magnetism as a dipole field, or that of a simple bar magnet. But it's not quite that simple. Field lines do not simply make arcs over the earth that begin and end at the magnetic poles of our planet. The field is patchy. In some places there are regions where the field lines go in the opposite direction – a "reverse flux." Gubbins and his colleagues discovered that these patches changed over the past four centuries. Spots of reverse flux in the southern hemisphere that are now obvious, like the South Atlantic Anomaly, were barely present at all before 1840. This recent finding might suggest that the current decline in field strength comes from growing and migrating patches of reverse magnetic flux rather than an overall decrease in the Earth's field. Gubbins was awarded the Fleming Medal at the AGU Fall Meeting Honors Ceremony in 2004 for this and other achievements.

This research and discovery beautifully illustrates the importance of good data collection and record keeping in science. You never know what secrets may lie hidden in the mundane data that you collect. A quote from Eden Phillpotts that showed up on my Internet Explorer startup page last week seems appropriate: "The universe is full of magical things, patiently waiting for our wits to grow sharper."

Dayton Hamvention – The Florida vacation ended all too quickly, and we drove back to Illinois and were quickly returned to reality with a stationary low that dumped rain and unseasonably cool weather on the Great Lakes region for the better part of a week and a half. As I prepared for the next trip, the low finally moved off to the east and there were just a few pink and rose colored clouds reflecting the not yet risen sun as I headed off to Dayton Hamvention.

The weather was perfect for walking around and seeing what's new (and in the flea market, what's old) in Amateur Radio. Of course there were no exhibits of the latest VLF or Natural Radio gear – not even a mention – other than the couple of books on 136 kHz. radio offered by the RSGB (Radio Society of Great Britain).

Walking through a hamfest is like a study in the history of computer and radio technology. Fifty year old radios function pretty much like a modern radio, although they weigh a heck of a lot more, but 5-year old computer gear is hopelessly obsolete and not of much value to anyone. "Old" becomes very subjective. I broke down and bought one of those bright yellow 1960's Geiger counters with the red, white and blue Civil Defense logo for $10.00. It is a working unit, but I wanted it chiefly for decoration as a reminder of the "nuclear paranoia years" of my youth.

One of the few things that stuck out as "different" or "new" compared to other years was that LEDs are working their way into more and more lighting products, and the price keeps dropping. I bought a little penlight with a white LED on a 6 inch gooseneck for getting light into hard-to-reach places. I also bought several longer goosenecks, again with white LEDs on the end, that plug into the USB port on your laptop for illumination of the keyboard. That's a real handy device if the weight doesn't damage the USB socket.

One of the few truly innovative concepts working its way into Ham Radio is the "Software Defined Receiver", or SDR. I attended a 1½ hour SDR forum on Saturday afternoon where several speakers brought us up to date on the latest SDR innovations. There is at least one commercial receiver and one transceiver being marketed, and there are several "open-software" and "open-hardware" projects in process with heavy volunteer participation.

The hardware for most of these receivers is extremely simple with the de-modulation, selectivity, and control functions being handled by the computer and the soundcard. The technology of a true SDR goes well beyond a conventional receiver that is simply controlled by the computer with the soundcard doing a little filtering.

I was able to purchase the SoftRock 7.0 kit for one of these receivers for $14.00 from Tony Parks, KB9YIG. This receiver is set up for 10 meters. I have also ordered the 160 meter SoftRock 6.0 receiver which I hope to modify for VLF. The board is tiny, the parts count is low, and open-license software is available o the web. Tony has limited quantities of kits available for sale on the web. Search for "SoftRock 6.0" to get more information and ignore all the results for easy-listening radio stations.

Of course an SDR for Natural Radio doesn't need any frequency conversion, and an active antenna or JFET front-end hooked into your soundcard is all that is required. Of course, processing software like Spectrum Lab is a great enhancement.

New Products – While we're on the subject of Software defined receivers, there are a couple of new products that might be of interest to those who are hard core Natural Radio listeners.

M-Audio has come out with their Audiophile 192 PCI buss soundcard. This audio card records at 24 bit resolution and samples at 192 kHz. That's over 110db of dynamic range! The card has both balanced and unbalanced analog ins and outs as well as digital ins and outs. The street price of the card is around $179.00

Now, imagine the possibilities here. Hook an active antenna to the input, and you can record all of the Natural Radio spectrum, many VLF stations, and WWVB, all in a single stream.

For example, say you wanted to research the effects of SIDs (Sudden Ionospheric disturbances) on chorus and other VLF emissions. In a single recording, you would have the Natural Radio spectrum to listen to, several VLF stations to monitor for sudden enhancements, and WWVB to have a perfectly accurate timestamp to the whole recording.

I would estimate that recording at this bandwidth would require about 2 gigabytes of storage per hour, but with the current price of hard drives, that's not too bad.

Another new item from M-Audio is their Micro Track 24/96. This little hand held professional audio recorder weighs just over four ounces and records to a compact flash card. It can sample at 16 or 24 bit resolution at rates up to 96 kHz. There are line level and phantom powered microphone inputs. (If you're really clever, you can use the phantom power to supply your remote J-FET front end.) The unit can be powered by your USB port or the included lithium-ion battery or AC adapter. Battery life is around 4 to 5 hours. Street price is around $400.