Don Lancaster's

Tech Musings

July, 1999

Web referral log reader
Life as we don't know it
Fast access to data sheets
Small "miracle" antennas
An impulse radar update

Any "miracle" antenna that is quite small yet still efficient would sure be a winner. AM radio stations could get rid of their large towers. Hams could easily meet the most restrictive of homeowner's covenants.

Portable gear would get even more so. Broadcast band AM DX or FM DX would be a breeze. Especially in cars and trucks. And "the next big thing" of pulse radio we recently looked at in MUSE135.PDF on *www.tinaja.com* would certainly benefit.

Sadly, *Maxwell's Equations* and a few related obnoxiously depressing physical laws tend to get in the road. While some new "miracle antennas" are now being highly touted, I found the ones I looked at did not stand up very well to close scrutiny. There's a bunch of real-world disappointments, hype, and wishful thinking here.

Hard data is often not there. And, most conspicuously, nobody seems to be stealing the plans for an obvious zillion dollar opportunity.

It turns out any traditional antenna has to be somewhere near a quarter wavelength or larger in size to end up efficient. And significantly larger if it is also to end up highly directional. And nothing beats sheer line-of-site height at high frequencies.

Yet the time *is* ripe for genuine antenna breakthroughs. Thanks to our new abilities to analyze and model complex electromagnetics. The new ease to integrate antennas with their driver or sensing electronics. Plus the switch to very broadband comm. And potent new techniques for effectively dealing with complex antenna arrays. And new digital coding schemes that give lower signal-to-noise ratios.

Perhaps "holographic rf", even.

Some Antenna Fundamentals

Maxwell's equations tell us that a time varying current can radiate as a free space electromagnetic field. The purpose of any antenna is to act as a *launching means* between guided and free space electromagnetic waves. Or vice versa. The "guiding" might be in the form of a wire, a coaxial cable, a stripline, or an actual waveguide.

Let us look at a few fundamental antenna properties…

duality– Most antennas work equally well in both directions, being able to transmit or receive. The math works equally well either way. Subject to power and overload limits.

regions– Most antennas do have two regions, called the *near field* and the *far field*. These are sometimes called the *Fraunhofer* and *Fresnel* regions. In your near field, behavior is highly complex and most energy drops off with the *cube* of distance. In the far field, properties are more orderly and most energy falls off as the *square* of the distance. The crossover between near field and far field takes place at $2L^2/\lambda$. Or around a wavelength for a normal antenna.

Figure one shows us how the field strength drops with distance on most typical antennas.

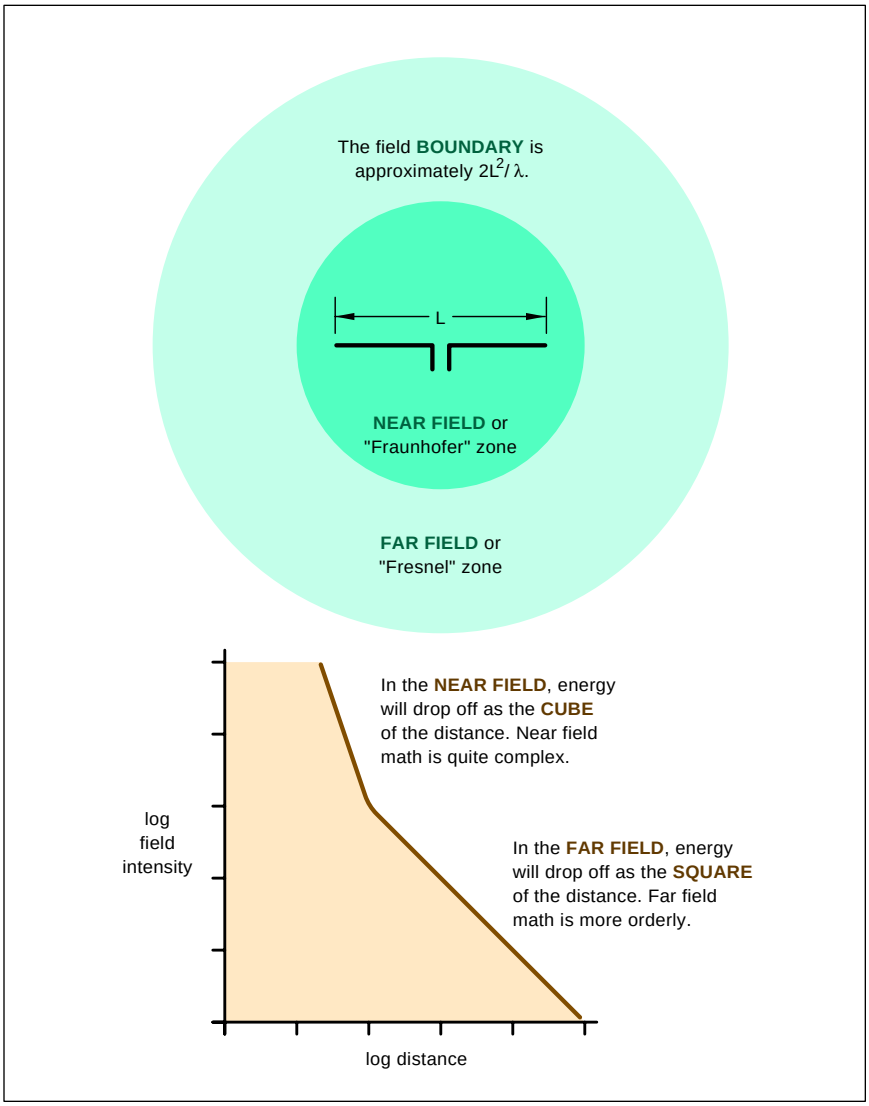

Fig. 1 – TYPICAL ANTENNAS HAVE a "near" and a "far" field. Behavior of the two regions is radically different.

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Treatise on Electricity & Magnetism (James Clerk Maxwell)

AM Broadcast Station Antenna Systems (Patrick M. Griffith)
Antenna Design : A Practical Guide (George J. Monser)
Antenna Engineering Handbook (Richard C. Johnson)
Antenna Theory : Analysis and Design (Constantine A. Balanis)
Antenna Theory and Design (Warren L. Stutzman)
Antenna Toolkit (Joseph J. Carr)
Antennas (John Daniel Kraus)
Antennas and Waveguides for Nonsinusoidal Waves (Harmuth)
The ARRL Antenna Book (Amer Radio Relay League)
Integrated Active Antennas (Julio A. Navarro)
Limited Space Shortwave Antenna Solutions (Frank Hughes)
Microstrip Antenna Analysis and Design (Daniel Schaubert)
Mobile Antenna Systems Handbook (K. Fujimoto)
Modern Antennas (A. Papiernik)
Phased Array Antenna Handbook (Robert J. Mailloux)
Practical Antenna Handbook (Joseph J. Carr)
Practical Wireless Communication Antennas (Leo Setian)
The Radio Amateur Antenna Handbook (William I. Orr)
The Right Antenna (Alvis Evans)
Yagi Antenna Design (Lawson)

For more details, see ***www.tinaja.com/amlink01.html***

Fig. 2 – SOME RECOMMENDED antenna books.

pattern– Any antenna that can radiate equally well in all directions is called an *isotropic* antenna. Usually, you'll want an antenna to send or gather in energy in a desired direction. Thus creating a special antenna radiation *pattern*. Patterns get created by the arrangement and size of the antenna *elements*. The more, the merrier.

For instance, a TV satellite antenna must have a very narrow beamwidth, because the desired bird has a weak signal in a fixed position. But a GPS nav antenna usually has to follow six wandering birds at once. So, it should have a half-hemispherical pattern that looks equally well at the entire sky.

Terrestral TV transmitters create a "bagel" pattern since there's no point in blasting excess energy up or down. Multi-tower AM broadcast antennas purposely "throw nulls" at the nearest neighbor stations for lower nighttime interference.

gain– The gain of any antenna is a comparison of how good it appears in a given direction compared to some reference antenna. The reference will usually be an isotropic radiator or a dipole. In its best direction, a good dipole gives you a gain of 1.64 over isotropic. A TV transmitting antenna having a gain of five will create the illusion of a 50 kilowatt transmitter ERP or *effective radiated power* in its prime reception area with only 10 kw or so of actual rf input.

Very small antennas traditionally have had uselessly low gain values.

radiation resistance– If you replaced an antenna with a dummy load which corresponds to the energy outflow, you'd have a resistor equivalent to its *radiation resistance*. The radiation resistance of free space is 377 Ohms. Small antennas tend to have uselessly low radiation resistances. Trying to drive into these creates monumental losses (and often outright burnout) of the matching networks used.

matching– Transmission line theory tells us that an antenna will *reflect* or kick back energy that's not properly coupled. A *Standing Wave Ratio* or SWR is a way to measure how much incoming energy actually will make it out the antenna.

A SWR of unity is ideal.

For proper matching, the incoming line impedance must get transformed to the radiation resistance. Also, most antennas get "tuned" to eliminate as much L or C reactance as possible at frequencies of interest.

Physically small antennas tend to have a very low radiation resistance and strong reactances. These can be exceptionally hard to properly match. Especially at higher power levels or over a wider bandwidth.

effectivity– The *effective height* of an antenna is the comparison of how it performs compared against a single quarter wave element. Your *effective*

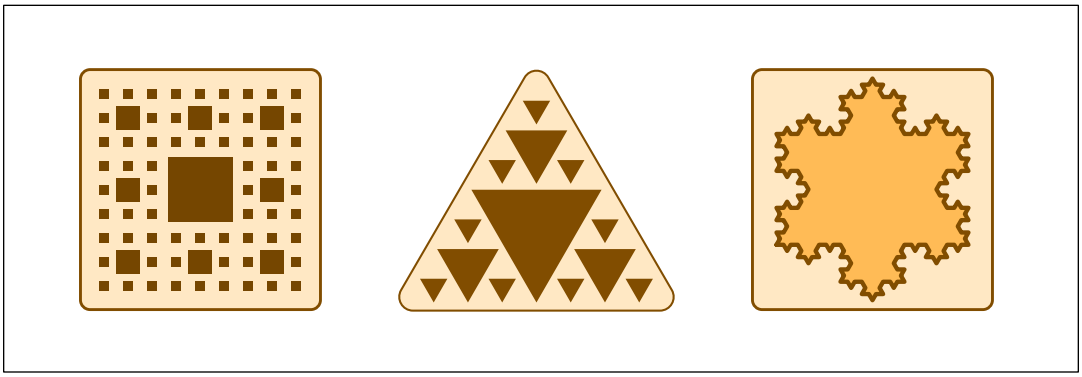

Fig.3 – SOME POSSIBLE 2-D FRACTAL antenna designs.

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area can measure how much energy is actually gathered in. For instance, placing a large resonant loop near an AM radio dramatically improves its sensitivity. Most small antennas have small effective heights and effective areas. This severely limits both their efficiency and error rate.

Your key paper here is Wheeler's *Fundamental Limitations upon Small Antennas* from way on back in those *Proceedings of the IRE*, #35, 1947 pp 1479-1484. Where you'll find that the big problems include low gain, lower radiation resistance, poor bandwidth, very difficult matching, and dramatic differences between theory and real world patterns.

Some useful antenna books appear in figure 2. You might check into my *www.tinaja.com/amlink01.html* to get more info on these titles.

Here are three "miracle" antenna concepts that might not end up being all that they seem…

The Crossed Field Antenna

Did the NAB (National Association of Broadcasters) recently get sucked into an old pseudoscience scam? Or has a revolutionary antenna design finally been given the credence that it rightfully deserves?

Their presentation in question is Brian Stewart's and Fathi Kabbary's *MW Broadcast Cross Field Antennas* session presented April 19, 1999 at the NAB99 Las Vegas Convention. In which a commercial Egyptian AM broadcast antenna gets decribed that supposedly is a barrel shaped scant 1/50th of a wavelength. Yet gives a claimed efficiency much higher than a conventional design.

The concept is based upon a 1992 patent #5,155,495. When you look at Maxwell's equations, it turns out that a radiating electromagnetic field can be created by one of two terms. One term is that usual current change. The second term tells us that em radiation can occur from any pair of capacitor plates driven in quadrature.

Conventional theory and practice has strictly limited this alternative to the near field only.

In ten years, hams experimenting with a painfully obvious need have yet to come up with any CFA which was even remotely useful. Problems include matching networks blowing up when they try to drive a very low radiation resistance. Plus a lack of field strength and sensitivity.

Theoreticians seem to have found and published explanations that seem to demolish the CFA concept. And I've been unable to find any credible peer-reviewed papers published in any of the expected journals.

Despite all the obvious benefits of such a stunning breakthrough.

Critics who visited their Egyptian site felt that sand and exceptionally poor grounds severely degraded the original vertical antenna; that their still-in-place older antenna somehow acted as a resonator; and their line currents were not allowed for. They also felt the station test equipment to be out of calibration.

Lots of ongoing lively newsgroup discussions on the CFA are found in *rec.radio.amateur.antenna* The usual searching at *www.dejanews.com* also gives you lots of CFA stuff to study. So does punching *CFA* and *antenna* into *www.hotbot.com*. More on NAB at *www.nab.org*. A few construction projects on cross field antennas can be found at *www.antennex.com*

I've gathered together some CFA references for you as our resource sidebar. You can view them and form your own conclusions.

```
% REFERRAL LOG EXTRACTOR

% Copyright c 1999 by Don Lancaster, Box 809, Thatcher, AZ, 85552.
% (520) 428-4073 don@tinaja.com www.tinaja.com All rights reserved.
% Consulting services available per http://www.tinaja.com/info01.html

% Fully annotated version appears in http://www.tinaja.com/post01.html
% Use TWO reverse slashes when ONE is wanted in a filename PS string!

/sourcefilename (C:\\medocs\\logfile.txt) def   % log file to be read
/targetfilename (C:\\medocs\\ xtinfile.txt) def   % referral file to be made
/searchphrase (tinaja) def                      % exclusion term to filter on

/workstring 20000 string def                    % start service procs

/checkline {dup searchphrase search addtooutfile1}
{pop pop pop} ifelse}  def

/addtooutfile1 {(http://) search {pop pop dup (?) search not {addtooutfile}
if}if} def

/ws {writefile exch writestring} def

/startoutfile {targetfilename (w+) file /writefile exch def (\n\nLines NOT
containing ) ws searchphrase ws( in document ) ws sourcefilename
ws (:\n\n) ws} def

/addtooutfile {ws (\n) ws} def

/endoutfile {(\n\n) ws writefile closefile} def

/grabphrase {sourcefilename (r) file /workfile exch def startoutfile {mark
workfile workstring readline {checkline}{exit} ifelse cleartomark}loop
endoutfile pop} def

grabphrase                                      % this actually does it
```

Fig. 4 – A WEB REFERRAL LOG READER written in PostScript.

Two Other Contenders

A second small "miracle" antenna is that CTHA, short for *contrawound toroidal helical antenna*. In which a pair of radiating wires get wound in opposite directions around a toroidal (doughnut) shaped form. Uh, this one starts off looking good theoretically, but seems to pick up problems when it's actually applied in the real world. Especially near a ground plane where the pattern tends to downgrade. Gain values also tend to be quite low.

Integral Technologies found up at *www.itechfin.com* is one info source. That *Contrawound Toroidal Helical Antenna* paper by the West Virginia University's CIRA research center is one useful reference. Get this one at *www.cira.wvu.edu* US patent number #5,734,353 might be of interest here and can get easily viewed by way of my *www.tinaja.com/patnt01.html*

As with the CFA, visit *Deja News*,

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SOME CFA ANTENNA REFERENCES

Papers –

A Conventional Explanation for the Crossed Field Antenna, M. Smith, *Electronics Letters* #28, 13 Feb 92, p360-361.

CFA - No Tricks, M. Hatley *Electronics World/Wireless World*, Dec 92, p1007.

CFA - RIP? Colin Davis, *Electronics World/Wireless World*, May 93 p405-407.

Fundamental Limitations of Small Antennas H.A. Wheeler, *Proc IRE* #35, 1947 p1479-1484.

Is This Antenna For Real? Chris Anderson, *Radio World*, March 31, 99, p26-29.

Misguided CFA K. Donaldson, *Electronics World/Wireless World*, May 93, p837-838

An Operational MF Antenna using Poynting Vector Synthesis M. Hatley, *Antprop Conf 7 part 2 #333 April 91 p645-648.*

Three MW Egyptian MW Broadcast Cross Field Antennas, Brian Stewart & Fathi Kabbary, *NAB Convention* NAB99, Las Vegas, April 19, 99.

Critique –

Electronics World/Wireless World: Mar 1989, page 216; Nov 1989, page 1109; March 1990, page 253; Dec 1990, page 1094; June 1991, page 476; July 1992, letters; May 1993, page 405; Sept 1993, page 747; Dec 1993, letters.

Patents –

US# 5,155,495 View through the link at *www.tinaja.com/patnt01.html*

Construction Plans –

Antennex online magazine at *www.antennex.com*

Newsgroups –

rec.radio.amateur.antenna
sci.physics.electromag
uk.radio.amateur

Hotbot, *rec.radio.amateur.antenna* or *www.antennex.com*.

A third new option is that *fractal* antenna. Which could be any pattern repeating or *self-similar* design. Such as a classic log periodic. But newly tends to use fractal math patterns.

Otherwise known by their wiggly wires or big bunches of holes. Fractal antennas do seem to offer somewhat smaller sizes and moderately broader bandwidths than traditional designs. They make nice student projects.

Big time uses have yet to appear.

One leading researcher is Nathan Cohen. *Fractal Antenna Systems* up at *www.fractenna.com* appears to be a leading commercial site.

The fractals used apparently can be two- or three-dimensional. Figure 3 shows some possible small and flat 2-D fractal antenna designs.

Several 3-D fractal antenna student projects appear at *www.antlab.ee.ucla.edu/~johng/fractal.html* The classic fractal shapes include Sierpinski, the Koch curve, the Koch Island, and the Mandelbrot tree.

Additional antenna analysis can be found at *www.tinaja.com/info01.html*

Reading Web Referral Files

I sure like to apply PostScript as a general purpose computer language. PS is really superb at reading most any file in nearly any format. Your easily written PostScript code can be sent to *Acrobat Distiller*. Or else to its *Ghostscript* alternative.

Creating your choices of a screen or a printable page, a displayed and recorded log message, an actual I/O control, or a new disk file. The latter written in any format you like.

Much more on all this appears on *www.tinaja.com/acrob01.html* and at *www.tinaja.com/post01.html*. Start off with file DISTLANG.HTML That *PostScript Reference Manual* or red book from *Adobe* is essential reading. At *www.tinaja.com/amlink01.html*

How are people reaching your web site? Which of the banners and links are effective? Your answers to these questions are found in the *log files* that your ISP should be giving you. Two problems though. The files can be long and difficult to read.

Webtrends or other reporting apps often do report the amazingly useless discovery that "your site" or "none" are your most popular referrals. And thus the only ones reported on.

Wowie gee.

Log file details appeared back in MUSE124.PDF and in similar files on my website. Figure four shows us a simple PostScript log file reader.

Rather than extracting all of those individual fields, we simply note that a *http://* string normally appears *only* at the beginning of the referral info. And that a "?" anywhere in the string probably comes from a search engine rather than another site.

This PS code reads your log file a line at a time. It searches each line for the *http://* magic marker. If this is found, the rest of the referral will be tested for the *absence* of your host site name *or* for any search engine. If useful, it writes the valid remainder of the referral to a new disk file. This file is easily viewed or modified to HTML code for web access.

Note that you should rename your log file as *logfile.txt* and remove any ending nulls from it for this code to work as shown. And always use *two* filename reverse slashes inside a PS string for every *one* you want.

Watch this detail.

For a simple mod, remove the *not* after the "?" search. This time, you get a list of *only* your search engine queries. Thus telling you what people are looking for when they find your site. Which can be very handy.

Fancier PostScript-as-Language examples let you extract all reference url's in your Acrobat files and then semi-automatically test all of them for valid links. Find this one as my file PDFLINK.PDF that I've uploaded to *www.tinaja.com/blat01.html*

Lots of great opportunities here. Also try *comp.text.pdf.*

NEED HELP?

Phone or email all your US Tech Musings questions to:

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NAMES AND NUMBERS

Adobe Acrobat
1585 Charleston Rd
Mountain View CA 94039
(800) 833-6687
www.adobe.com

American Sci & Surp
3605 Howard St
Skokie IL 60076
(708) 982-0870
www.sciplus.com

Analog Devices
PO Box 9106
Norwood MA 02062
(800) 262-5643
www.analog.com

AntenneX
PO Box 72022
Corpus Christi TX 78472
(361) 855-0250
www.antennex.com

Brand Electronics
421 Hilton Rd
Whitefield ME 04353
(888) 433-6600
www.brandelectronics.com

C&H Sales
PO Box 5356
Pasadena CA 91107
(800) 325-9465
aaaim.com/CandH/index.htm

Cira/WVU
PO Box 6690
Morgantown WV 26506
(800) 344-WVU1
www.cira.wvu.edu

Fractal Antenna Systems
2 Ledgewood Pl
Bellmont MA 02478
(617) 489-8824
www.fractenna.com

Hitachi
2000 Sierra Point Pkwy
Brisbane CA 94005
(415) 589-8300
www.hitachi.com

Integral Technologies
1401 Seventeenth St 11th Fl
Denver CO 80202
(888)666-8833
www.itechfin.com

Linear Technology
1630 McCarthy Blvd
Milpitas CA 95035
(408) 432-1900
www.linear-tech.com

Natl Assn Broadcasters
1771 N St NW
Washington DC 20036
(202) 429-5300
www.nab.org

Pivot Point
225 N Highland St
Hustisford WI 53034
(800) 222-2231
www.pivotpins.com

Radio World
5827 Columbia Pk #310
Falls Church VA 22041
(703) 998-7600
www.imaspub.com/rw.html

RF Design
5660 Greenwood Plz Blvd #350
Englewood CO 80111
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www.rfdesign.com

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Time Domain
6700 Odyssey Dr
Hunstville AL 35806
(256) 922-9229
www.time-domain.com

WebTrends
621 SW Morrison #1025
Portland OR 97205
(502) 294-7025
www.webtrends.com

An Update

In our recent pulse radio tutorial of MUSE135.PDF, I purposely omitted any mention of government lab work. As someone with a strong aerospace radar background, I felt their whole program seemed highly questionable from the get-go. For real eye-openers on tax dollars at work, view *www.house.gov/science_democrats/archive/mirrpt99.html* plus all the info up at *www.time-domain.com/news.html*

Impulse radio does offer incredible potential. Don't miss out keeping up to date on this emerging topic.

New Tech Lit

From *Hitachi*, new CD ROM data on their *H8 Embedded Controllers*. From *Linear Technology*, a LT1328 IRDA infrared receiver.

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From *Analog Devices* a single chip 7175A digital to NTSC encoder. From *SGS*, the new series of Class D audio amplifiers. Such as their nice 18 watt TDA7481. We saw more on similar amps in MUSE128.PDF.

Your quickest and easiest ways to get free data sheets on most anything electronic is to click on either of the DATA or QUEST links on my *Guru's Lair* homepage at *www.tinaja.com*

Understanding Range Limitations of Low-frequency Unlicensed Transmissions is found in *R.F. Design* for April of 1999 pages 36 to 50. We may look at this in a future column.

Dark Life is an outstanding new book by Michael Taylor. Evidence is fast mounting that the most common life form on earth is life *as we don't know it*. As rock eating subminiature cave bugs who would consider the inside of your car battery "cool but cuddly". Whose lifestyles are based on a sulphur oxidation that is done in total darkness.

This has big-time implications for everything from SETI explorations to cancer cures. Taylor's book is also a highly readable "like it is" glimpse into cavers. I have personally been underground with quite a few of the researchers he mentions.

A new line of accurate low cost power meters are now available from *Brand Electronics*. And Brad Mock's *Technical Works* has his new line of fast and low cost prototyping aides, PIC and otherwise. Click through on my web banners to reach these.

A broad variety of quick release pins and similar fastener solutions is available from *Pivot Point*. I'd sure like to use them on *Nissan Pathfinder* rear seats. Please let me know if you know of any ready-to-go aftermarket products that solve this obvious need. There seems to be a big-time product being missed out on here.

My favorite two surplus stores are *American Science and Surplus*. Plus *C&H Sales*. Both offer free catalogs. Lots more surplus bargains are up at *www.tinaja.com/barg01.html*. Newly with photos and online ordering.

Such as the 60 kilowatt triple load bank, a quality CO2 incubator, and a printed circuit plate-thru lab.

For all the fundamentals of digital integrated circuits, do check into my *CMOS* or *TTL Cookbooks*. Either by themselves or as part of my bargain priced *Lancaster Classics Library* per my nearby *Synergetics* ad.

My latest website additions up at *www.tinaja.com* now include greatly expanded content for my three *Tech Musings*, *Blatant Opportunist*, and *Resource Bin* ezines.

As usual, mentioned items should appear in our *Names & Numbers* or *CFA References* sidebars. Be sure to look here first. A reminder that free answers to easy tech questions can be gotten by phoning or emailing me per the *Need Help?* box. Please be sure to include your email address if you expect a personal reply.

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