The Venerable J-Pole Evolves

Synopsis

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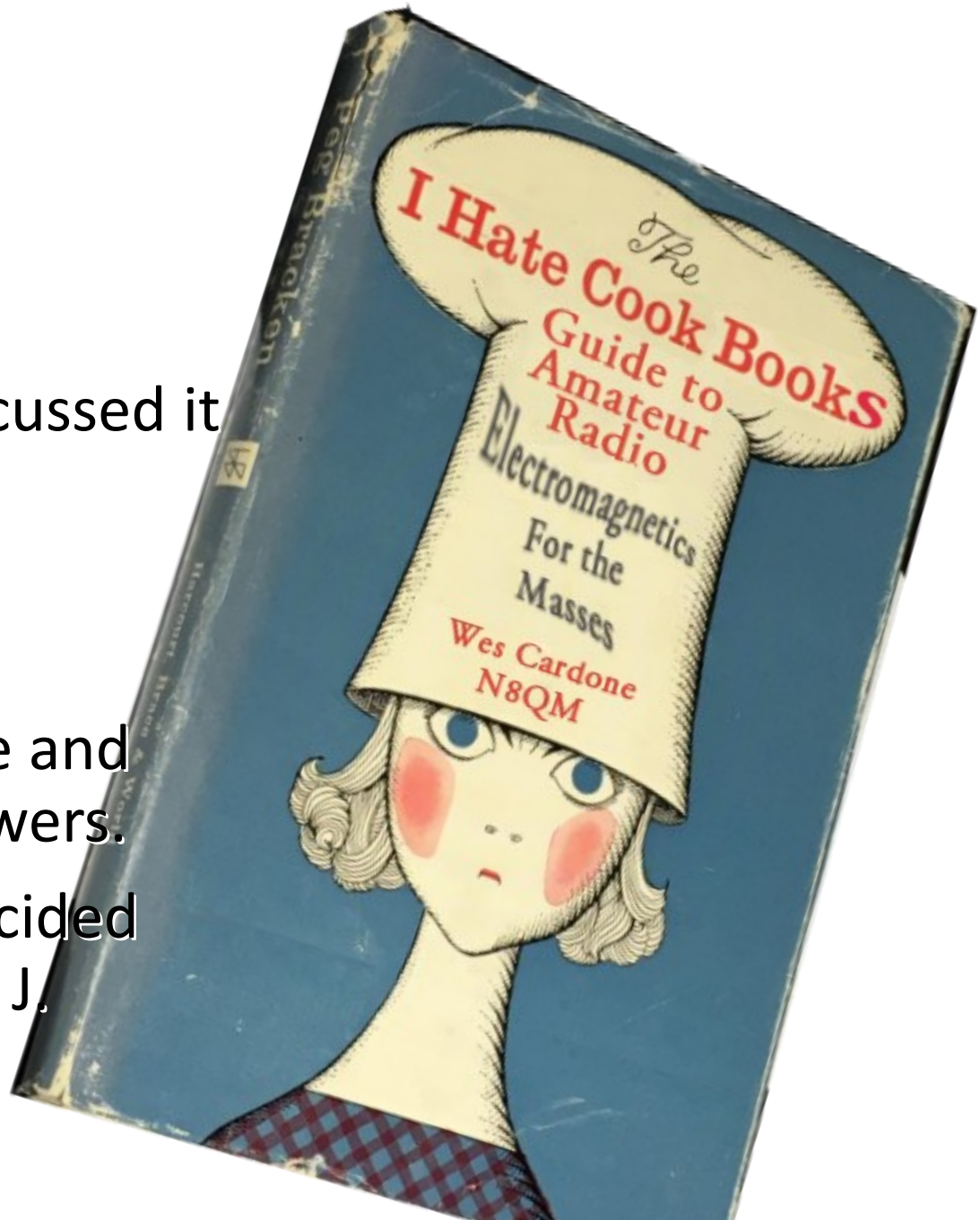
Notice to the Reader

- Most amateur radio station operators
  - understand these qualitative basics
  - But are not prepared for a quantitative discussion.
    - A professional engineering background (dosed in electro-magnetics) is required to assimilate this material without some prep-time.
- When this is presented to the amateur community it will have to be in at least three presentations.
  - Presentation 1 will cover the dipole basics.
  - Presentation 2 will cover using the Smith Chart to quantify parameter transitions.
  - Presentation 3 will present the whole ball of wax reviewing 1 and 2 before showing how the dog-gone thing works, stem-to-stern.
- **BUT:**
  - Nothing, absolutely NOTHING, is presented that is beyond what the FCC Extra Class exam expects from those testing for the Extra Class license.

Let It Be Known…

- Let it be known that I hate cookbooks.
- Everywhere you see J-Pole antennas discussed it is almost always cookbook-style.
- What is cookbook-style:
  - Monkey-see, monkey do.
- I have always wondered about the J-Pole and the wisdom behind it. I still have no answers.
- I looked at the J-Pole analytically and decided that I did not like the bottom part of the J.



Why I Hate the J-Pole

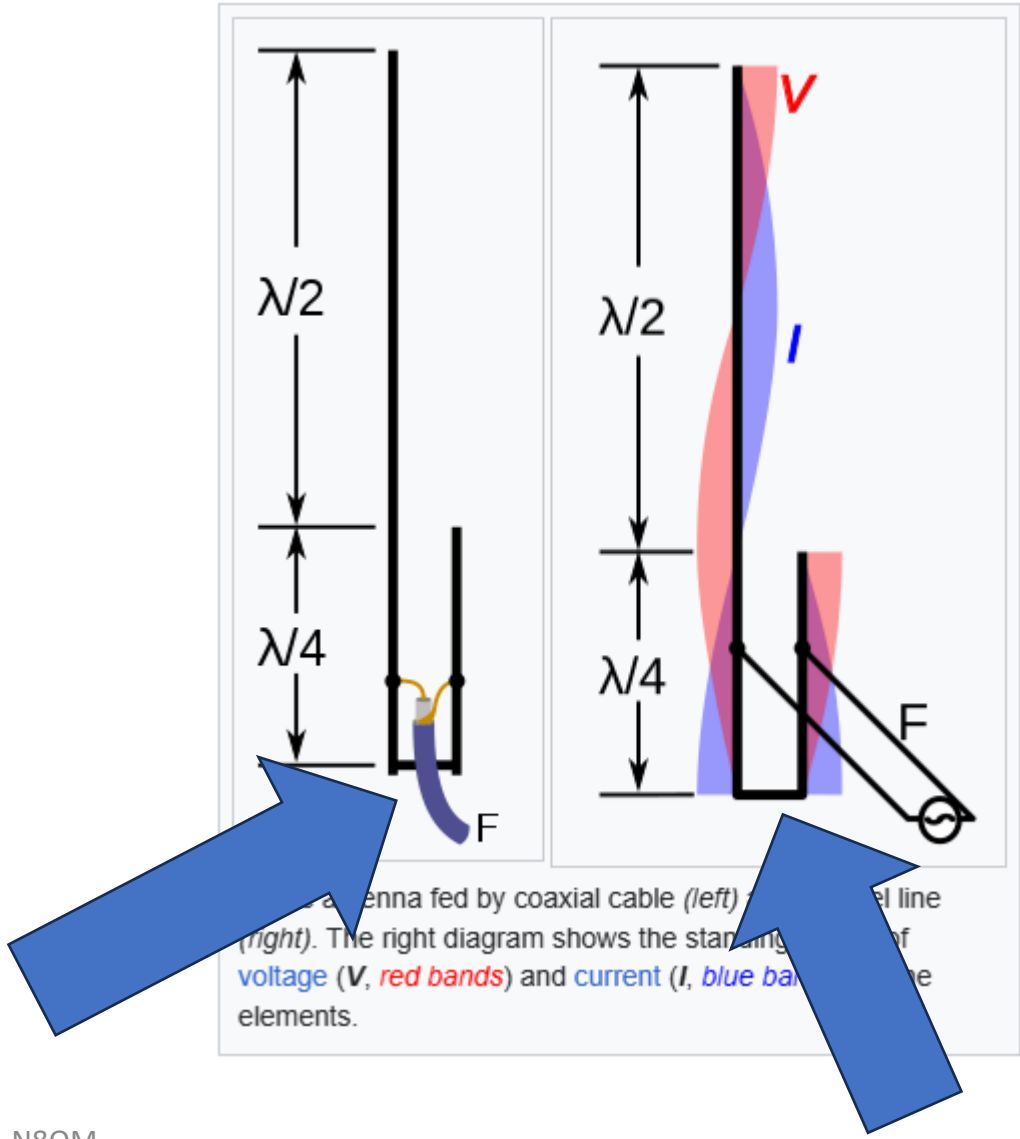
- The J-Pole antenna is a superlative piece of work.
- It has many important and significant roles in amateur radio.
- But it has a flaw this author has been unable to explain and has not found anyone who addresses what this author considers to be a flaw.
- How to you find the location for the feed-point?
  - The solution is hunt-and-peck.
  - The solution criteria is a minimum SWR ignoring the vector impedance.
  - This VIRTUALLY GUARANTEES that there will be unnecessary reactance that has not been nullified.

What this Author Proposes

- This author proposes the "**Rail Pole**" which is very similar to the J-Pole. The theoretical *modus operandi* is nearly the same.
- We will make one very important modification that transforms the J-Pole into a highly designed item very much outperforming the J-Pole while retaining its most impressive application attributes.

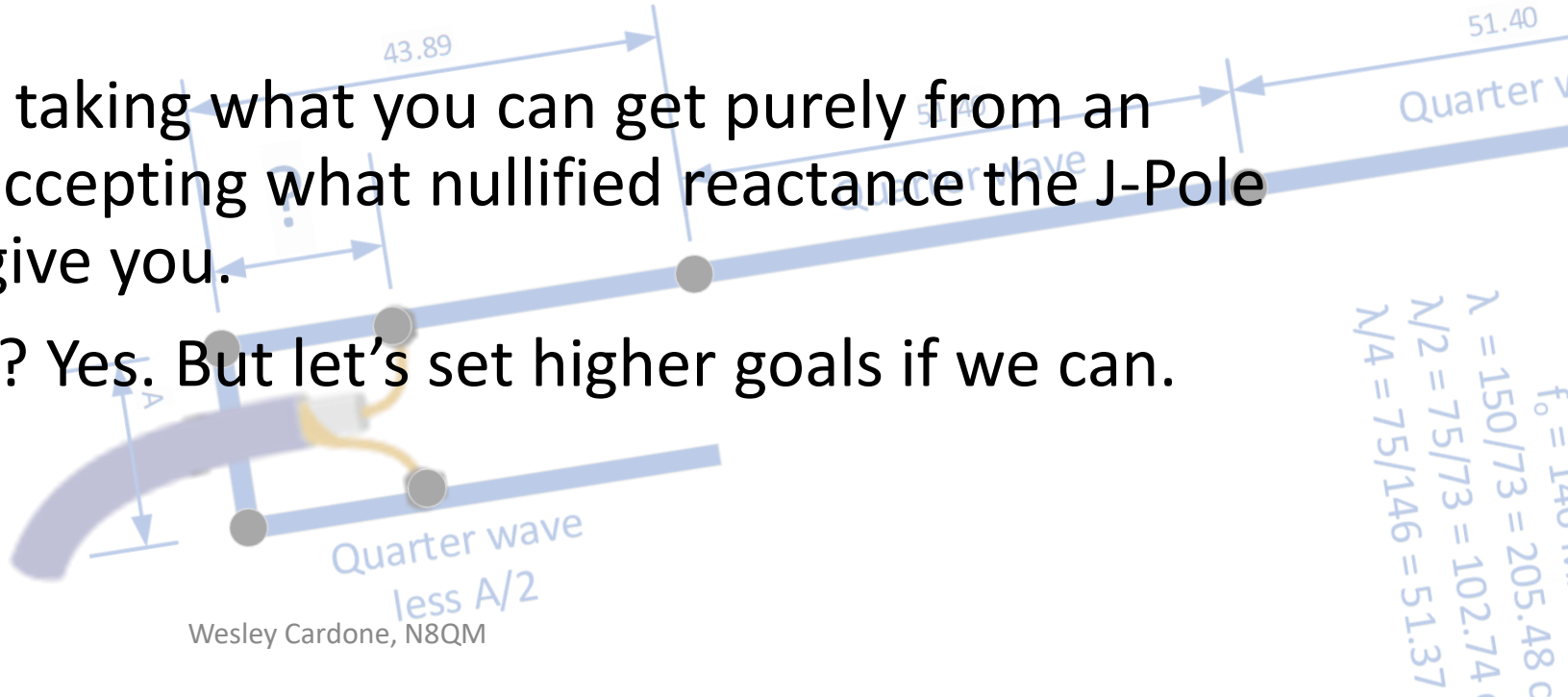
The Venerable J-Pole

- See Wikipedia for the story
- Can be thought of as an
  - End-fed half-wave antenna
  - Bottom quarter is a transformer
    - Low impedance
    - Transformed to a high impedance
- But have you wondered why the shorting stub?
- The author challenges the viewer to find this discussed anywhere.



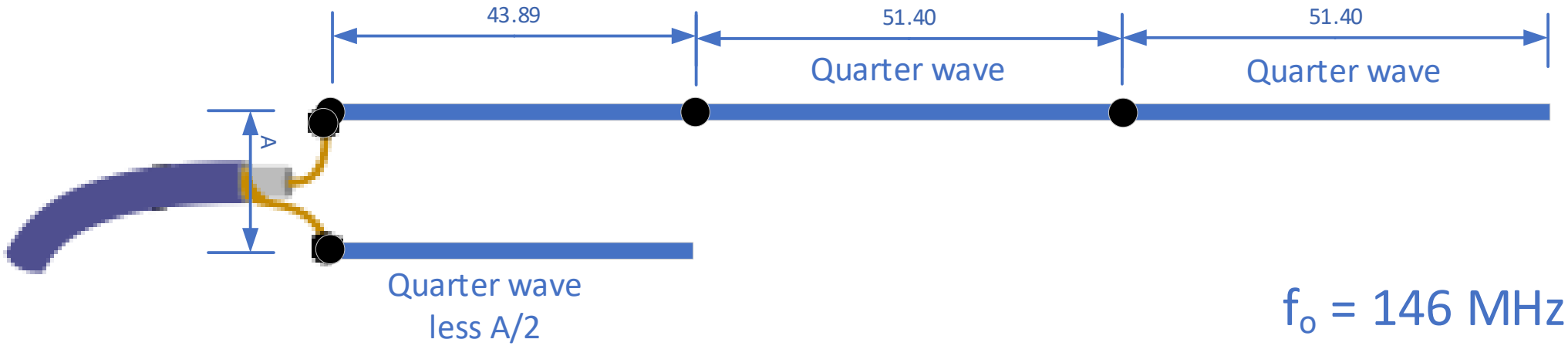
What IS Virtually Guaranteed?

- An acceptable feed-point location for the J-Pole is that which exhibits the closest you can get to |Z| = 50 Ohms.
  - This is without regard to a vector impedance.
- This VIRTUALLY GUARANTEES a needlessly high (but acceptable) antenna reactance.
- Why? Because you are taking what you can get purely from an SWR perspective just accepting what nullified reactance the J-Pole is gracious enough to give you.
- The J-Pole works, right? Yes. But let's set higher goals if we can.



Enter the Rail-Pole

- Let's dump the un-needed parasitics.
- Dump the shorting bar
- Pretend the impedance transformation section (the U) is a center-fed dipole antenna.
- Connect the feed-point as if a dipole antenna.
- Then design an L-Match tuning stub.



f_o = 146 MHz

λ = 150/73 = 205.48 cm

λ/2 = 75/73 = 102.74 cm

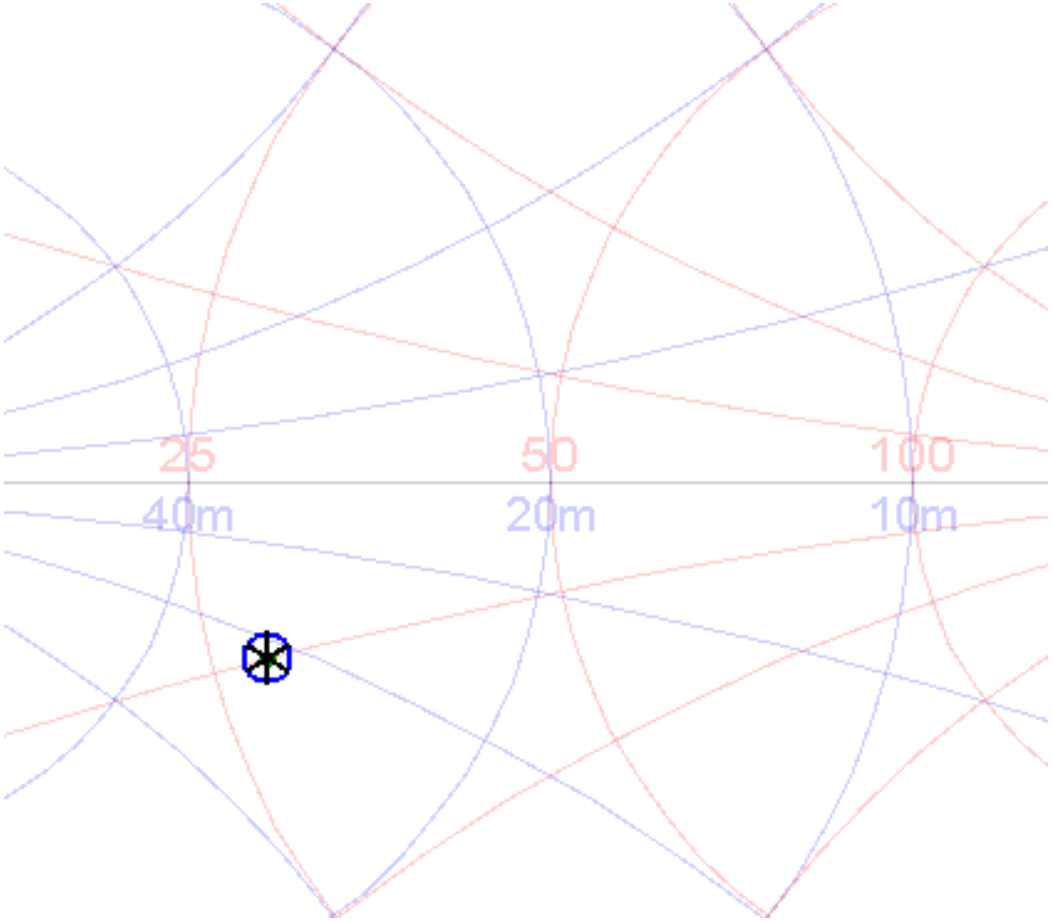
λ/4 = 75/146 = 51.37 cm

In Order to Appreciate…

- Must comprehend the optimal basis for antennas
  - Z = 50 +/- j0.0 Ohms
  - |Z| = 50.0 Ohms is not good enough
- SWR
  - Is not the Holy Grail
  - Is a valuable tool
  - When < 2 for a named frequency
    - means you are okay for that frequency
  - When for a band sweep the SWR (2-meters for example)
    - 142 MHz to 148 MHz SWR is never better than 1.5
      - Means you can do a lot better for a design goal

Consider an Example

- f_o = 146 MHz
- Z = 28 – j10.0 Ohms
- SWR = 1.9
- It works for 146 MHz
- But no way the bandwidth will cover the 2-meters allocation.



The Rail-Pole Objective

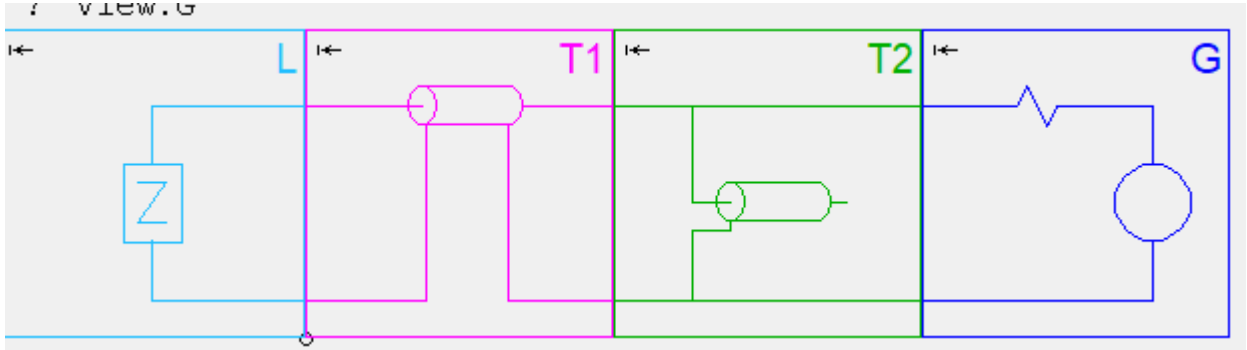
- Rigidly define a center-band frequency reactance nullification
- Use a feed-point location at the bottom of the rail
  - The reactance will be nullified for the named frequency
  - The real resistance will be way too low.
  - Counter with a 2-step L-Match process
    - Add or subtract phase such that movement occurs to a
    - Add reactance to neutralize what is there
  - The L-Match (located at the feed-point) becomes an integral part of the antenna.

But Does it Work”

- The L-Match (located at the feed-point) becomes an integral part of the antenna.
  - May be made using discretes or
  - Cut lengths of coax (probably less than 12” in all cases)
- The vector impedance, Z (we are NOT talking |Z|)
  - Z = 50 +/- j0.0 Ohms for f_o in all cases
  - Z = 50 +/- j0.0 Ohms for $3f_o$ in all cases
  - This assumes the L-Match may be constructed to the dimensions required.
- Bandwidth
  - will easily cover the entire amateur allocation at less than SWR=2
    - 2-meters
    - 70 cm

The L-Match

- There are usually 3 or 4 topologies an L-Match may be made to.
- Pick the one easiest to fabricate.
- For practical considerations, coax lengths are not possible shorter than 2 or 3 inches.
- In many cases, the lengths required are too short to be able to construct.
  - This results in an acceptable loss of accuracy.
  - Use discretes to counter for ultra -precision.



Questions