Publication of the Northern California Contest Club

April 1996 Issue # 287

Club Repeaters W6RGG/R 147.24+, 442.200 (107.2PL)

NCCC JUG

Ken's Pen

dePresident, WM2C

Where should I point my antenna during a contest to maximize rate/score?

Easy question, but the answer is a little less clear. Sometimes it's obvious as to where to point your antenna, other times its contrary to intuition. If you want to work the USA, East usually does the trick from California. But this is not always the case.

Often the direct beam heading works well, but often the incoming path is not direct. The path can be skewed, via backscatter, or via longpath. When and where to point your antenna is the key to maximizing your score. Often there are multiple paths open at any given time, so sometimes you will need to pull yourself away from the JA run to catch the late afternoon Africans. Its hard to do, but you can bet a seasoned competitor will know when and where to look.

How do you know which is the best direction? Well, a lot is based on experience. But often if you just ask your NCCC colleagues where to point you antenna, you will get lots of great ideas. And of course by trial and error, since conditions are always changing.

This past weekend in the SSB WPX, 10m was a great example of requiring experience AND trial and error to find the best path. 10m was open to South America during most of our daylight hours, and even well past dark on their end (at least at N6RO's). The direct path was the way to go for South America. But with the antenna pointed nearly due south, we were working a few W4s and even a few ZLs. Trying to maximize the potential to work more ZLs and maybe a VK, we turned the antenna directly on ZL, but that made things worse. Turning back to South America, and we got called by another ZL almost immediately.

Often in marginal conditions as we are now having, the best place to point your antenna is the area of best propagation. While this maximizes your signal to that area, it is also quite likely that this is the best place to point your antenna for unlikely paths. 15m during the WPX was another good example. On Saturday, 15m was open to JA, but closed down after a while. I turned the antenna to VK/ZL, which was still coming through, and I was rewarded by a new series of JA callers. I turned the antenna back to JA, and JA signals almost disappeared. Back to VK, and the JA's called again. This is a typical skewed path, an one to consistently check. Another typical skewed path from here is over Africa. If Africa is coming in well, but EU is almost non-existent on the direct path, point your antenna to Africa, and you will often be called by Southern European stations.

Knowing when to check for longpath can also pay off. Many times on 20m in the morning, EU might be weak via short path, but may be louder via long path. Often listening carefully for signals that have the typical long path flutter will be the key that you should take a closer look at long path.

The bottom line is you need to exercise your rotator in order to find the best path. The best path may be less than obvious!

Many thanks for the opportunity to serve the NCCC. Please give the next round of NCCC officers a boost of confidence by turning out for the NCCC elections to be held Wednesday April 17 at the H.P Santa Clara location. Elections are being held on Wednesday, since that Friday is Visalia! 73, and CU in the pileups. Kenny , WM2C

WRTC-96 PRESS RELEASE #7

Redwood City, CA
April 3, 1996

WRTC-96 ANNOUNCES SELECTION OF TEAM MEMBERS

WRTC-96, Inc. announced today selection of the 104 team members who will compete in the World Radiosport Team Championship competition scheduled for July 13 and 14, 1996. The WRTC competitors will enter the IARU HF World Championship contest as 52 two-person multi-operator, single-transmitter entries. All 52 teams will be located near San Francisco Bay on flat terrain in relatively close physical proximity so as to minimize propagation differences, and all will run 100 watts output to nearly identical antenna systems. By eliminating many of the station and propagation variables normally associated with radio contesting, the WRTC strives to present a meaningful head to head competition in which the winners can rightfully claim to be "the best of the best."

The WRTC competition will begin at 12:00 UTC on Saturday, July 13 and run until 06:00 UTC on Sunday, July 14. The WRTC teams will operate both cw and ssb on 40, 20, 15 and 10 meters and may be contacted once on each band-mode (i.e., 8 contacts are possible with each WRTC station). The WRTC stations will be easy to identify because they will be using distinctive "1x1" callsigns specially approved by the Federal Communications Commission for the competition. Those callsigns will be W6A through W6Z and K6A through K6Z. In addition to the regular IARU HF Championship awards, there will be a whole family of separate achievement awards available to those who work the requisite numbers of WRTC stations.

Twenty-two teams operated in the first WRTC competition which was held in Seattle, WA in 1990. Eleven competitors in this year's event, including Defending Champions K1AR and K1DG, are veterans of WRTC-90. Their callsigns are noted with asterisks in the competitors' listing:

1. Defending Champs	K1AR* + K1DG*
2. Team Argentina	LU6ETB + LW9EUJ
3. Team Australia	VK5GN + VK2AYD
4. Team Belgium	ON6TT + ON4WW
5. Team Brazil	PY5CC + PY0FF
6. Team Bulgaria	LZ1SA + LZ2PO*
7. Team Canada #1	VE3EJ + VE3IY
8. Team Canada #2	VE7NTT + VE7CC*
9. Team Czech Rep.	OK1CF + OK2PAY
10. Team Finland	OH2IW + OH1JT

6. Team Bulgaria LZ1SA + LZ2PO*
7. Team Canada #1 VE3EJ + VE3IY
8. Team Canada #2 VE7NTT + VE7CC*
9. Team Czech Rep. OK1CF + OK2PAY
10. Team Finland OH2IW + OH1JT

11. Team France	F6FGZ + F5MUX
12. Team Germany #1	DK3GI + DL1IAO
13. Team Germany #2	DL5XX* + DL1VJ
14. Team Hungary	HA0DU + HA0MM*
15. Team Italy #1	IN3QBR + IT9TQH
16. Team Italy #2	IT9BLB + IT9VDQ
17. Team Japan #1	JE1JKL*+ JH7WKQ
18. Team Japan #2	JH4NMT + JE3MAS
19. Team Japan #3	JH4RHF + JA8RWU
20. Team Japan #4	JH7PKU + JO1BMV
21. Team Lithuania	LY2IJ + LY1DS
22. Team Poland #1	SP6AZT + SP9FKQ
23. Team Poland #2	SP9IJU + SP9HWN
24. Team Russia #1	RV1AW + RW1AC
25. Team Russia #2	UA3DPX + RZ9UA
26. Team Slovenia	S59A + S56A
27. Team Spain #1	EA4KR + EA1AK
28. Team Spain #2	EA7TL + EA9KB
29. Team Sweden	SM3DMP + SM3CER
30. Team UK	G3OZF + GI0NWG
31. Team Ukraine	UT4UZ + UT1IA*
32. Team USA #1	K1KI + K3UA
33. Team USA #2	K3LR + WA8YVR
34. Team USA #3	K4BAI + KM9P
35. Team USA #4	K6LL + N2IC
36. Team USA #5	K8CC + K5GO
37. Team USA #6	KF3P + KR2J
38. Team USA #7	KR0Y* + K1TO
39. Team USA #8	N6TV + K7SS
40. Team USA #9	W2GD + W0UA
41. Team USA #10	WX3N + K5ZD
42. Team Yugoslavia	YU1RL + YT1AD
43. Wildcard #1	5B4ADA + S53R
44. Wildcard #2	9A9A + 9A3GW
45. Wildcard #3	DJ6QT* + DJ2YA
46. Wildcard #4	I2VXJ + I4UFH
47. Wildcard #5	K4UEE + N6IG
48. Wildcard #6	NP4Z + WC4E
49. Wildcard #7	RU3AA + RV3AJ
50. Wildcard #8	UN2L + UN4L
51. Wildcard #9	WN4KKN + N6TR
52. Wildcard #10	ZS6EZ + ZS6NW

For additional information about WRTC-96, contact Rusty Epps, W6OAT at 651 Handley Trail, Redwood City, CA 94062, USA or via e-mail at epps@netcom.com. Past press releases and related WRTC information are available by sending an e-mail message to wrtc-info@dumpty.nal.go.jp with the two commands #GET HELP and #GET INDEX on separate lines within the body of the messge. You also may access the WRTC-96 Worldwide Web site at http://ourworld.compuserve.com/homepages/n6ip

Contest Calendar de NF6S

April 12-14
Japan HF CW Dx Contest
April 25-26
Int'l HF Contest/Chernobyl Memorial
April 27-28
Heilvetia (HB9) Contest
May 4-5
ARI International DX Contest
May 25-26
CQ WW WPX CW Contest
June 22-23
ARRL Field Day
July 13-14
IARU HF World Champ/WRTC '96

Northern California Contest Club
Treasurer's Report - 31 March 1996

Income Category	Budget	Actual
Membership dues	4500	4038
Advertisements	300	300
General fund contributions	300	251
Vanity callsign contributions	70	51
CQP contributions	0	280
Non-member JUG subscriptions	0	12
Total income	5170	4932
Expense Category		
JUG publishing & special mailings	(3620)	(2157)
NCCC share of CQP expenses	(500)	(0)
Membership awards	(650)	(63)
Visalia Hospitality	(100)	(0)
Vanity callsign for club call	(70)	(51)
CQWW, WPX etc. awards	(125)	(0)
Contingency	(105)	(45)
Self-funding activities (Banquets, badges, etc.)	(0)	(23)
Total expenses	(5170)	(2359)

Balance at start of Fiscal Year 95-96	5931
Present General Fund Total	4273
Present Checkbook Total	5563

Respectfully submitted, George Daughters, AB6YL
31 March 1996

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The JUG is the journal of the NCCC, published monthly. Copies are mailed to members whose dues are up to date. Send material for publication before last Monday of each month.

CQP Results on Web Site

They're up!
Took quite a while to reformat, but they came out great.
Check em out at http://ourworld.compuserve.com/homepages/n6ip/cqp

April Contest Tip

During the early spring months its a excellent opportunity to take a look at your contest station and effect repairs and improvements.

Tower/Guys: Inspect your tower and guys for corrosion. Pay particular attention to the guy hardware and apply good corrosion maintenance on the tower and guying system.

Rotator: Inspect the rotator, cabling, connectors and hardware. Pay attention to lubrication of the rotator. If its been in the tower for a few years, it should be looked at.

Coax: Check all coax connections. Pay attention to weather seal boots, or taping. Check the coax service loop for wear and possible damaged outer coax sleeve. If you use cable ties to secure the coax to the tower check them. If they are not IR resistant they will break easily and should be replaced. Use Black cable ties.

Shack: Labeling Items in your shack such as antennas, amplifier settings, which relays select which antenna, etc., is a station must. Label coax feeds and/or rotator control lines.

The above items may just help prevent a catastrophic failure when your into a serious contest this fall.
Larry NF6S

NCCC ELECTIONS

When: Wednesday, April 17, 1996
Why Wednesday? Friday is Visalia!
Location: H.P Santa Clara, Auditorium downstairs
Time: 6:30 for Pizza (From Give Pizza Chance)
7:30 for elections and NCCC relevant discussions
Come out to elect the new NCCC Officials!!

Found on the Internet

Something I've wanted to do for a long time now is set up a web page devoted to *operating*. A common theme on this (and the contest) list has been "listen to the Olde Timers, for they have knowledge." In some cases this actually turns out to be true :-)

I would like to start collecting some of that wisdom and place it online.

One of the more popular topics has been: how do I get a *#@! QSL out of XY0FOO? I know there are people on the DX list who can provide a lot of experience and advice on this one! "Contesting 101" is another popular topic. (Have any of you *not* followed the recent "when and how to sign your call" discussion on the contest list? :-) SSTV? VHF DX? QRO? They all have their quirks. The "hot" operators of today only got there on the shoulders of their mentors.

Nearly everyone reading these lists does so because they want to learn.But if everyone just listens, the list (and the web site, and the ham community at large) soon starts looking (and sounding) like 10m. The band may be open, but if nobody calls CQ there won't be any contacts.

So why do this here? Glad you asked :-)

You may have seen some of the online "amateur radio magazines" that have popped up on the Web over the last six months. It seems like every one of them has turned into a commercial advertising forum with nothing but ad's. And with the exception of a few sites, most of the ham radio web pages are just links to other sites containing links to other sites, ... Once you go through 25 levels of recursion you just feel like turning off the computer. One of the goals I had in setting up this site was to provide *original* material for the ham community. Doing this requires *input* from the ham community. I've seen some pretty bright people post insightful information to the lists here; I know you're out there. How about sharing your knowledge in a more permanent setting?

Obviously, writing for the web site doesn't pay as well as writing for the ham rags. (Although the difference is pretty small.) Considering the information you have *received* from the lists and the web server, this shouldn't be an issue, anyway. Why not spend some time contributing back to the ham community?

There are *many* subjects that could be covered:

- What are the tricks involved in getting a QSL from arare DX station?
- How not to make a QSL manager mad.
- Why it's important for the "little-gun" stations to send in a contest log!
- Station grounding (or: No More TVI!)
- Why AX25 BBSs are eeevil :-)
- How do I get <mumble>log to run under Windows95?
- The joys of 6m DXing
- *Effectively* using the Packet Cluster network
- Getting the most bang-for-the-buck using city-lot antennas
- 0 - 60 in 58 seconds: CW for the musically impaired etc.

Get the drift? Crank up your copy of Word Perfect and have at it! Share the wealth! Fame and fortune await! (Well, maybe a link in the Lycos index ...) Ideas, comments, submissions, whatever, to me via private e-mail, please. (Don't CC the lists.) If your English won't pass the parser, but your C (or FORTRAN :-) will, don't be shy! I have plans for you, too :-)

Finally, based on the recent feedback I've received about the ve7tcp.ampr.org system, I'm thinking about setting up a new mailing list for the purpose of discussing where the system should go in the future. Let me know if you're interested in joining. (Beware that proposing an idea will usually make you the project leader :-)
--lyndon (still trying to find time to get the Drake back on the air ...)
From: Lyndon Nerenberg (VE7TCP) <lyndon@ve7tcp.ampr.org>

Internet Tibit
1997 Contest Calendar - Help!

Dear Friends,
I plan to make a contest calendar for 1997, which should have included also colour pictures from various contest stations. I should be very glad if I could add also Your station (antenna farm, detail or operation position). If You have such a picture in a good colour quality (best way as DIA or bigger print) and You will agree to include it, please let me know. I will send You a SASE.

73 Karel, OK2FD
rstudio@login.cz

Why an Antenna Radiates

You don't have to know how an antenna works to use one, but getting a handle on this subject can deepen your understanding of radio. Here's a searching look at the mysterious process by which our antennas hurl energy from Here to There.

by Kenneth Macleish, W7TX
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Part 2

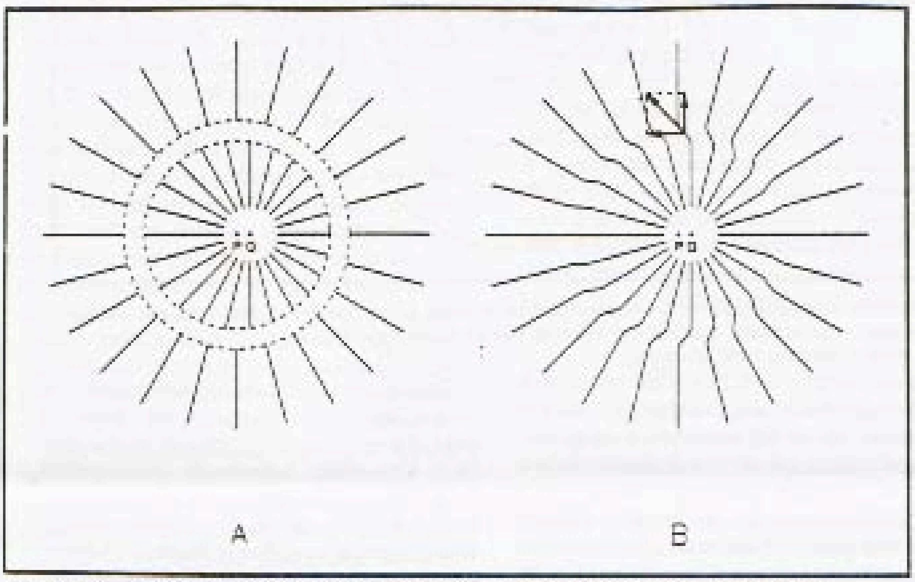

Fig 3—The electric field of an electron that was accelerated recently. The resulting disturbance in the field is traveling outward at the speed of light. The transverse component of the disturbed field is the radiation field.

Why an Accelerating Electron Radiates

We've described the radiation field of a vibrating electron, but we haven't yet explained why it happens. The answer is hidden in Fig 3A.

Suppose that, until a short while ago, an electron was held at rest at point P in Fig 3A. It was then accelerated briefly to the right by our tweezers and afterward was kept moving to the right at constant speed. At the present time (which we'll call time zero), the electron is passing point Q.

Fig 3A contains two circles. The larger circle (the outermost broken line) is centered at P and has radius equal to the distance light would travel in the interval from the beginning of acceleration until time zero. The smaller circle is centered at the spot occupied by the electron at the end of acceleration; its radius is equal to the distance light would travel between the *end* of acceleration and time zero. As time marches on, the circles evidently grow at the speed of light. The space between the circles is equal to the distance light would travel during the period of acceleration. If the electron moves slowly in comparison with light, as it does in an antenna, the distance it covers during acceleration is small compared to the size of the circles, so the circles are nearly concentric. For clarity we have greatly exaggerated the distance PQ; it too would be very small if drawn to scale. Now we can determine what the electric field must look like at time zero.

Outside the larger circle, the field at time zero is a stationary coulomb field centered on P, as if the electron had never started to move.[5] Inside the smaller circle, the field is a moving coulomb field centered on the electron's present position, point Q. Between the circles the field is intermediate between the fields in the other two regions.

Now connect the field lines across the space between the circles and erase the circles, making Fig 3B. You can see that the electron, while accelerating, gave birth to an expanding electromagnetic disturbance. In the disturbed region, as shown by the arrows, there is a transverse field component—the radiation field—in addition to the outward-pointing coulomb field.

The radiation field resulting from a *vibrating* electron, Fig 2, is simply a continuous series of such disturbances caused by successive intervals of changing acceleration and deceleration.

The Bootstrap Forces

The radiation and induction fields of a vibrating electron exist right down to the electron's surface. Since the electron's surface carries an electric charge, and since an electric charge is pulled by an electric field, it's fair to ask whether these fields are able to exert forces on the very electron that is producing them. In other words, can an electron "feel" its own dynamic electric field? The answer is yes. The electron is pulled by its own bootstraps! The tweezers that are providing the motive power must overcome the bootstrap forces.[4]

The bootstrap forces are responsible for two very important properties of a conductor: radiation resistance and inductance.

Radiation Resistance Versus Ohmic Resistance

By our definition, an alternating radiation field is in phase with the accompanying magnetic field. At the surface of a vibrating electron the magnetic field is essentially in phase with the electron's speed, so here the radiation field, and the bootstrap force exerted by it, are likewise in phase with this speed. The direction of the force is such as to resist the electron's motion. It is evident that the force feels to our tweezers like a drag proportional to speed, as if the electron were moving through a viscous fluid. This drag force is the cause of radiation resistance.

An electron moving in a conductor also feels a drag force that is due to frequent progress-impeding collisions between the electron and the atoms in its path. This drag is the cause of ohmic resistance, the familiar R in Ohm's Law.

Both kinds of resistance dissipate energy at a rate equal to the resistance times the square of the current. Of course, energy dissipated this way doesn't actually disappear.

An alternating current, flowing against *radiation* resistance, turns electrical energy into radiant energy, which wings its way off into space. Current flowing against *ohmic* resistance transforms electrical energy into heat, which is mechanical vibration of the atoms of the conductor—the atoms vibrate when they're hit by the moving free electrons.

Radiation resistance varies along the length of an antenna wire, but it is independent of the diameter and material of the conductor. The middle third of a half-wave, 14.1-MHz dipole has a radiation resistance of 3.7 ohms per foot. That's nearly 80 times the ohmic resistance of clean #12 copper wire at this frequency. Closer to the ends of the antenna, the radiation resistance is even higher.

Inductance

At the surface of a vibrating electron, the induction field, being 90 degrees out of phase with the magnetic field, is 90 degrees out of phase with the electron's speed (ie, the current). The bootstrap force of the induction field therefore opposes *the rate of change of current* rather than the current itself. Here we see the underlying cause of the property of inductance. In reacting to this bootstrap force our tweezers deliver energy *to* the electron during acceleration and receive back an equal amount of energy *from* the electron during deceleration. The delivered energy is stored in the magnetic field around the moving electron and is returned when the magnetic field collapses as the electron slows down.

Because the bootstrap force of the induction field is proportional to acceleration, it feels to the tweezers just like mechanical inertia. In consequence the electron has an *effective inertial mass* that greatly exceeds its gravitational mass.

Now let's step back and look at the fields in and around an entire antenna. You will recognize that the basic principles involved apply to any kind of antenna. Because of its simplicity, we will use an isolated, center-fed, half-wave dipole as an example.

The Big Picture

If our antenna doesn't contain any pithballs, it doesn't contain any tweezers either. What is it, then, that causes the free electrons to vibrate? In real life it takes an electric field to move an electron. Inside an isolated straight dipole, the motive power comes from the combined coulomb fields of all the charged particles, positive and negative, in the antenna. We'll refer to this combined field as the *antenna's* coulomb field.

In addition to the coulomb field, the antenna as a whole exhibits a magnetic field that is the sum of the magnetic fields of all the moving free electrons. It also sports a dynamic electric field that is the vector sum of the dynamic electric fields of all the free electrons. As we did with an individual electron, we can separate the dynamic electric field of the antenna at any point in space into two components, one in phase with the total magnetic field and the other 90 degrees out of phase. We will call the in-phase component the radiation field of the antenna and the out-of-phase component the induction field. Right at the antenna, both fields are parallel to the metal surface.

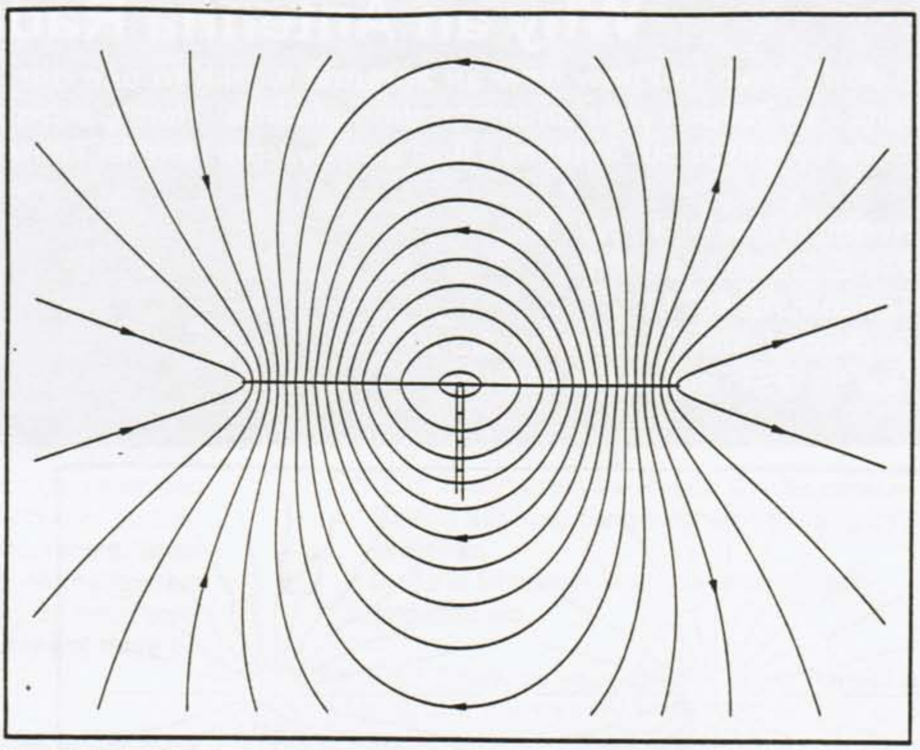

Fig 4—The coulomb field at an instant in time around a half-wave resonant dipole. A half-cycle later, the polarity, and all the arrows, will be reversed. The spacing between the field lines indicates field strength.

It happens that the coulomb field and the induction field fall off much more rapidly than the radiation field with increasing distance from the antenna. At distances greater than a few wavelengths from the antenna, in what is called the antenna's *far field*, the electric field is essentially pure radiation.[7] Closer to the antenna, we have the *near field*, which is a mixture of the radiation, induction and coulomb fields.

Action of the Coulomb Field

We see in Fig 4 a snapshot of the coulomb field near the antenna. This picture shows an instant in time when the right-hand half of the antenna is positively charged and the left-hand half is negatively charged, as a result of a process that we'll examine in a moment. A half-cycle later, the polarity, and all the arrows, will be reversed. The spacing between the field lines indicates field strength. At the antenna wire or tubing, the field lines are nearly, but not exactly, perpendicular to the metal surface.

On alternating halves of the antenna, the perpendicular component of the coulomb field tries to pull electrons out of the surface. This effort is generally unsuccessful in amateur antennas because the "work function" for copper or aluminum—the energy it takes to dislodge an electron from the surface—is too great. If the transmitter power is very high, though, the field may be strong enough to pull electrons out into the air. The result is an exciting (but power-wasting) luminous display called *corona*. But because the coulomb field leans slightly away from the perpendicular at the antenna's surface, it can always pull free electrons *along* the surface.

At one point in the RF cycle, free electrons throughout the antenna are moving to the right at or near their maximum speed. The right-hand half of the antenna thereupon begins to accumulate an excess of electrons, even if no single electron will shift to the right by more than a hundred-millionth of an inch. In the left-hand half of the antenna the departure of free electrons leaves an equal excess of oppositely charged metal ions, which are stationary atoms that have lost an electron. The coulomb field produced by this increasing imbalance of charges now opposes the electrons' rightward motion. By virtue of their effective mechanical inertia (also known as the bootstrap force of their induction field), the electrons coast for a while against the rising force of the coulomb field, which eventually brings them to a stop and then propels them back toward the left. After the electrons again reach maximum speed, now in the opposite direction, the foregoing scenario is repeated with left and right interchanged. The end result is the vibratory motion of free electrons that causes them to heat the metal and generate electromagnetic waves.

Newton's second law of motion tells us the relationship between the acceleration of an electron and the sum of the forces acting on it. In this case, one of the forces is the pull of the coulomb field parallel to the metal surface. The other two forces are the bootstrap force of the dynamic electric field and the drag of ohmic resistance. According to Sir Isaac, the sum of all three forces is equal to the gravitational mass of the electron times its acceleration. We will assume that an electron is so nearly weightless that its gravitational mass can be set to zero in this equation. Then the three forces must always add up to zero.

Turning this statement around another way, we can say that the dynamic electric field and the parallel component of the coulomb field partly cancel each other, the remaining field being just enough to overcome the drag of ohmic resistance. If the ohmic resistance is small enough to be ignored, the coulomb field is precisely equal and opposite to the dynamic electric field everywhere on the surface of an antenna.

This result leads to a procedure, which amounts to the construction and inversion of a matrix, for computing the current distribution on an antenna. Then, using the principles we've been discussing, we can compute the behavior of the system in detail.

Power Flow Through Space

Electrical engineers use the term *real power* for power that flows in one direction past a given point. They also speak of *reactive power*, which is power that flows back and forth in alternating directions with a net flow of zero in any one cycle. The radiation field of an antenna transmits only real power, which travels out toward distant localities without ever reversing direction. The induction field carries only reactive power, and the coulomb field carries both real and reactive power. Again we'll illustrate this with an isolated, center-fed, half-wave dipole.

Real Power Flow

How do you suppose your hard-earned RF power gets from the feed point to the rest of the antenna? You might think that it flows out through the wire or tubing of the dipole, but actually this real power is carried *through the surrounding space* by the coulomb field. Some lines of power flow are plotted in Fig 5.

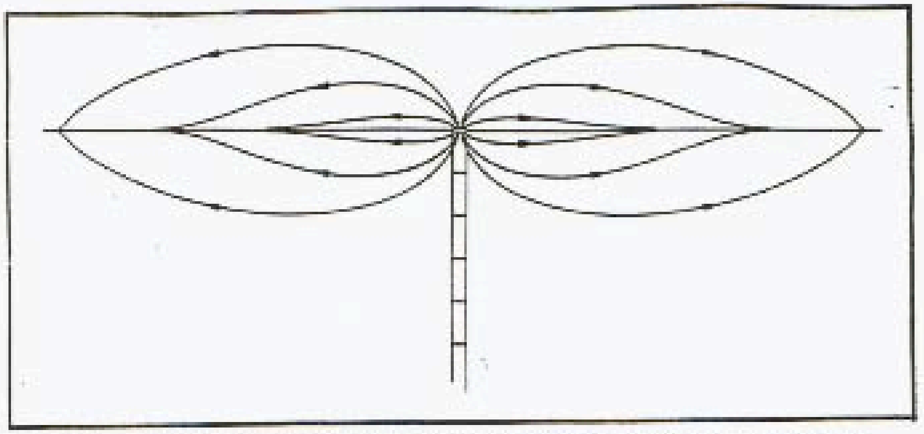

Fig 5—Flow of power from the feed point of a half-wave resonant dipole. The coulomb field around the antenna conductors carries power *through the space surrounding the conductors*.

As you see in the figure, when power coming up the feed line reaches the antenna it spews out into the air in all directions. It then arches to the right and left on curved paths that eventually intersect the antenna. At the points of intersection the coulomb field donates its real power to the free electrons, making up for the energy they are losing to ohmic resistance and radiation resistance.

Reactive Power Flow

During one interval in the RF cycle, the charge on the antenna reaches a maximum, and the current and the magnetic field go through zero. A quarter of a cycle later, the reverse is true. In the first interval, the antenna is surrounded by a cloud of electrostatic energy stored in the coulomb field. In the second interval, the coulomb field has disappeared, and we find the same energy stored in the magnetic field. The energy stored in the coulomb field is used in accelerating the effective inertial mass of the free electrons, which by their motion create the rising magnetic field. Energy thus moves from the coulomb field, via the induction field, to the magnetic field, only to move back again during the next quarter cycle as the magnetic field collapses. This is reactive power flow, with a net of zero.

You can think of the cloud of electrostatic energy as energy stored in the distributed capacitance between the two halves of the antenna. Similarly, the stored magnetic field energy can be thought of as energy residing in the distributed inductance of the antenna wire. If power is suddenly cut off by short-circuiting the feed point, the antenna doesn't stop radiating right away. Instead, it oscillates with diminishing vigor at its resonant frequency until the energy stored in the fields has been dissipated in ohmic resistance and radiation resistance. Our antenna can be accurately described as a resonant circuit made up of distributed capacitance, distributed inductance, and two kinds of distributed resistance.

Antennas and Non-Antennas

What do the following items have in common: a dipole antenna, a radar dish, the ground around a transmitting antenna, a coil and capacitor in parallel, and a wire carrying music to a loudspeaker? One answer: to a greater or lesser degree, they all radiate!

This is true because in operation they all carry time-varying currents and, consequently, accelerating electrons. The dipole antenna is an example of a distributed circuit that owes its existence to the fact that it radiates well. It is designed for efficient conversion of electrical energy into radio waves. But any system of conductors that carries varying currents behaves in accordance with the principles described earlier. The same processes, including radiation, take place whether we call the system an antenna or something else. For example, what we generally refer to as reflection from a conducting surface (the radar dish, the ground) is actually radiation from free electrons set in motion by incident electric fields.

In Sum

Perhaps the foregoing intuitive introduction to classical electromagnetic theory will inspire further development and refinement of the ideas presented. In any event, I hope you'll be able to contemplate an antenna, or a non-antenna, with a warm feeling for all the interesting things going on in and around it!

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