CARL & JERRY

By John T. Frye W9EGV

"A Low Blow"

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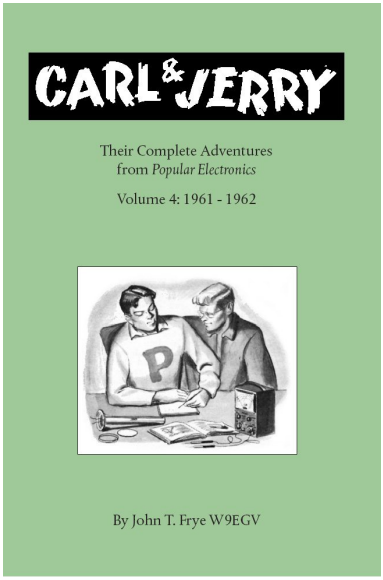

This story has been excerpted from *Carl & Jerry, Their Complete Adventures, Volume 4*. The print book contains 24 stories, originally published in *Popular Electronics* from January 1961 through December 1962. Printed books may be ordered through Lulu.com at the following URL:

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Copperwood Associates
Colorado Springs, Colorado

Carl and Jerry

March 1961

A Low Blow

It was two whole weeks since Carl and Jerry had talked face to face. Jerry had been home from school sick with influenza, and the boys' parents had kept them apart to prevent Carl's catching the virus infection. The two had managed to keep in touch by chatting on the phone, by talking over their ham stations, and—since their bedroom windows faced each other—even by blinking Morse code on flashlights from one window to the other. But Jerry had finally recovered sufficiently to be down in his basement laboratory this warm, windy Saturday morning, and to have Carl visit him.

"Hi, Jer," Carl said gruffly as he came in through the outside basement door. "How's my puny pal? You look kinda pale around the gills."

Jerry turned away from the large, wide-mouthed glass jar sitting on the workbench in front of him to bestow a fierce scowl on his friend.

"Don't 'puny pal' me, you big ox! Disgustingly healthy people make me sick!"

"Now, now, there!" Carl murmured with mocking solicitude. "We mustn't get upset. Remember: we are not well. And what are we doing with that goldfish bowl?"

"I am getting ready to test my infra-sonic microphone," Jerry said curtly, turning back to the fishbowl that had a thin membrane of rubber stretched over the top. Inside was a small, brass-topped glass jar containing some transistors and other components mounted on a little circuit board. Two tiny twisted wires of the sort used in

record-player tone arms came out of a wax-sealed hole in the bottom of the jar, ran up over the edge of the bowl beneath the rubber membrane, and were connected to the input of a tape recorder sitting on the workbench.

"I need more information than that," Carl cheerfully confessed. "What is this 'infrasonic' jazz? I've never heard you mention a project like that before!"

"In physics you *should* have learned that sound recognized as such by the human ear goes down in frequency to about 12-15 cycles," Jerry explained, "but there are other compression and rarefaction waves in the atmosphere at much lower frequencies. These are called 'infra-sonic waves,' and we are surrounded by them even when our ears hear nothing.

"They obey the same laws as sound waves: Their speed varies as the product of the square root of the absolute temperature and a constant related to the conducting medium.

"At 32°F," he continued, warming to the subject, "sound travels about 1087 feet per second in air, and the speed increases as the temperature rises. The rate at which sound power is absorbed and dissipated into heat depends on the frequency. The fraction of sound power absorbed per unit distance of propagation is roughly proportional to the square of the frequency. That explains why you hear the bass drum of an approaching band first, and it also means that only low inaudible frequencies can be propagated great distances."

Carl started to say something, but Jerry didn't give him a chance.

"When the volcano Krakatoa exploded in 1883 in the East Indies, inaudible waves from this disturbance traveled around the world several times with a pressure so great that it produced readable

deflections on barographs. The impact of the great meteor that fell in Siberia in 1908 had the same result. During World War I, it was noticed that cannon fire could be heard within a radius of 100 kilometers, and often beyond 200 km., but not *between* 100 and 200 km."

"The sound waves must have been skipping the way our radio waves do," Carl noted.

"Exactly! Observers figured that something far above the earth must be deflecting the sound waves back down. The only thing that could do so would be a layer of air warmer than the air at the earth's surface, which would speed up the top edge of the sound wave entering it at an angle and bend the wave back toward the earth. By listening for the lowest audible frequencies and by checking the transit time of the wave from the source to the distant observer, those smart cookies figured out *where* and *how warm* that layer of air had to be! Very recent information gathered by our space probes confirmed their calculations.

"As you go up in a quiet atmosphere," Jerry went on, "the temperature falls sharply at first and then zigzags back and forth until you reach an altitude of about 105 km. From that point on up, for at least a considerable distance, the temperature increases steadily, reaching much higher values than here—"

"Just a cotton-picking minute," Carl interrupted. "You didn't know all this when you got sick. How did you get so smart?"

"Some time back," Jerry explained, "I noticed a newspaper article about how the National Bureau of Standards was carrying on experiments on the detection and recording of infrasonic waves. I wrote the Bureau asking for more information, and Mr. Paul Walsh and Mr. Donald M. Caldwell kindly sent me a lot of interesting information about their installation near Washington, D. C."

"How do they work it?"

"They have four infrasonic microphones set up at different locations several miles apart. Signals from each mike are fed to a central location where they are amplified, bandpass-filtered, and recorded as ink-on-paper traces. By noticing the difference in time of the signal's arrival at various mike locations, its speed and source-direction can be determined."

"I can't imagine what sort of mike you'd use to pick up signals of one or two cycles per minute," Carl muttered with a thoughtful frown.

"Neither could I," Jerry agreed, "but the dope I got says the mike is a condenser type with a diaphragm of thin, specially-formed brass mounted on a reference volume. One side of the diaphragm connects to a noise-reducing pickup pipe. Movements of the diaphragm modulate the frequency of an oscillator."

"I see—I think," Carl said doubtfully, "but what's this about a noise-reducing pipe?"

"When the mike diaphragm is exposed directly to the open air, pressures produced by the wind develop a lot of signal-masking noise. These specially designed metal pipes lie on top of the ground and are each about 1000 feet long. Each pipe has 100 small holes distributed along its length. A signal traveling toward the microphone along the length of the pipe is attenuated very little, but random variations in pressure caused by wind turbulence are greatly reduced."

"What sort of sounds, or whatever you call 'em, are picked up?"

"Well, on May 5, 1960, when the weather bureau reported 19 tornadoes and funnel clouds in Oklahoma, Texas, and Kansas in a four-and-a-quarter-hour period, the microphones recorded waves of periods between 12 and 50 seconds with speeds about equal to that of sound in air and with pressures slightly less than one dyne per square centimenter. Hearing a tornado 1000 miles away is sharp listening! A system of detectors like this could track tornadoes. In fact, another installation is planned near Boulder, Colorado.

"On August 18,1959," Jerry continued, "sound pressure produced by the big earthquake in Montana was observed at the NBS Washington laboratories. An earthquake wave traveling along the earth's crust moves the surface up and down like the cone of a giant speaker and sends sound waves almost vertically into the atmosphere. Information gleaned from these waves valuably supplements data gathered by seismographs regarding the nature of a quake and its original source.

"Magnetic storms also produce strange 'sound' waves of periods greater than 20 seconds with a trace velocity up to three times the speed of sound. These waves usually arrive from the north during magnetic storms, and they have a large angle to the surface of the earth. The Bureau hopes to study them to learn more about the interaction of the sun and the earth's magnetic field."

"HOW did you make your mike, and what are you going to do with it?" Carl asked, as the ground shook with a low growl of distant thunder.

"I stretched a diaphragm of very thin brass shim stock tight over a little steel hoop. Another disc of brass mesh wire is separated from the shim stock disc by a thin insulating washer. This assembly, mesh disc down, is mounted on top of the little glass jar with an airtight seal. The homemade printed-circuit board inside the jar contains two transistorized crystal oscillators and a diode mixer to combine their outputs. The capacitor formed by the diaphragm and the screen is across one of the crystals. The two oscillators are tuned—you can tune a crystal oscillator a little, you know—so that their frequencies are only one kilocycle apart; and this means that the difference frequency of 1000 cycles comes out of the mixer. Any movement of the brass diaphragm produced by pressure waves against it is translated into a frequency shift of the crystal oscillator associated with the condenser mike, and an accompanying change in the beat-frequency tone coming out of the mixer."

"Hey, old buddy, that's pretty sharp!" Carl applauded.

"Nothing any bored American boy shot full of antibiotics couldn't do!" Jerry replied modestly. "The roughest job was drilling two holes through the bottom of the glass jar without breaking it. Leads from the mixer come out one, and the other is covered with a brass disc with a very tiny hole punched in it with a needle. That

keeps our mike from responding to very slow pressure changes caused by barometric variations, yet allows it to respond to waves with periods up to several minutes in length."

He switched on the tape recorder, and soon a 1000-cycle note was heard from the speaker. At the same time, a meter connected across the recorder speaker rose to half-scale.

"That's a simple audio frequency meter I've calibrated to indicate frequencies between 100 and 5000 cycles," Jerry answered Carl's questioning look. "We don't have any ink-on-paper recorders, but that meter pointer will swing back and forth in step with any low-frequency waves received. Tape-recording the changes in tone will give us a chance to double-check on any waves we think we observe. Now, let's see what happens when we test it out.

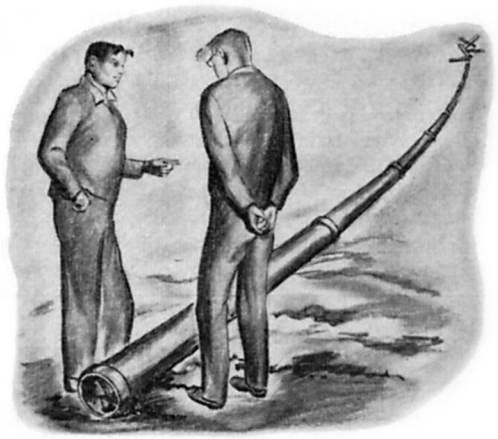
"I drop this little steel ball on the rubber membrane, like so, and this causes a very small increase in the pressure inside the bowl. See that meter kick down? If I've calculated right, it will start creeping back in a couple of minutes as air leaks through the tiny hole to equalize the pressures on both sides of the diaphragm."

The microphone passed the test with flying colors. It responded to very small changes in pressure; yet, if the pressure was left applied, the tone returned to 1000 cycles in the space of a few minutes.

"Now all you need is that pipe pickup," Carl remarked.

"We've got it!" Jerry said promptly. "Didn't you notice that the men laying that new 8" gas line in the street stopped directly in front of the house last night? Welders will weld the joints together Monday and put the pipe down in the trench, but right now it stretches out to the west on top of the ground for a couple of thousand feet with the joints all neatly butted tight together. I'm hoping small air leaks at these joints will serve as the holes in the pipe used by the National Bureau of Standards.

"The beauty of it all is that the weather bureau has a tornado alert out for the area to the west of us. We may be lucky enough to hear a tornado! Suppose you go out, Carl, and fasten our mike in the end of the pipe with this wooden collar, and run this twisted pair from it into the cellar window."



CARL carried out the assignment quickly because huge drops of rain had begun spattering down. When the wires were connected to the input of the tape recorder, the meter pointer immediately began to hunt restlessly up and down the scale.

"What we're looking for is a slow, rhythmic swing of the meter pointer," Jerry shouted above the roar of the wind outside, which had begun whipping up the trees and was now pounding furiously at Jerry's house.

But there was nothing slow or rhythmic about the pointer as it swung wildly up and down. Suddenly it began to go up and up, hesitated for a moment, and then fell back to zero and stayed there. The tone disappeared.

"Something's happened to our mike," Jerry shouted as he grabbed up his jacket and headed for the door. At the top of the steps he stopped dead in his tracks and stared up into the northwestern sky. Carl, looking over his shoulder, saw the writhing, twisting, unmistakable shape of a small tornado funnel high above the ground and moving off to the north. Even as the boys watched, the little tornado disintegrated.

They raced over to the pipe and pulled out their mike. The thin brass diaphragm was ruptured, with the jagged corners curled outward somewhat like the petals of a flower.

"Jer, look way down there at the other end of the pipe," Carl said in awe. Jerry followed his pal's pointing finger and saw that the straight line of the pipe was broken four or five blocks away, and the sections of pipe were scattered over the street like jackstraws. A small temporary tool house nearby had been smashed to kindling and the tools strewn about like scraps of paper.

"That little twister must have dabbed down squarely on top of the pipe and then hopped back up," Carl said thoughtfully.

"Yeah, and it sucked on that end of the pipe hard enough to bust our mike diaphragm at this end," Jerry finished. "The tornado dealt us a low blow. We aren't really sure our infrasonic mike works."

"I'm not complaining," Carl said philosophically as he started back for the house. "We're mighty lucky the twister was sucking on *that* end of the pipe and not on *our* end!" -30-

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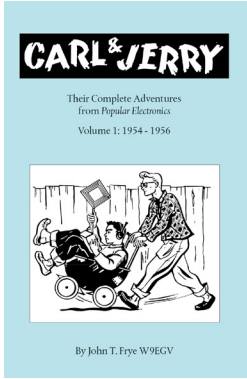

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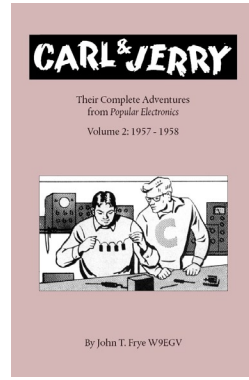

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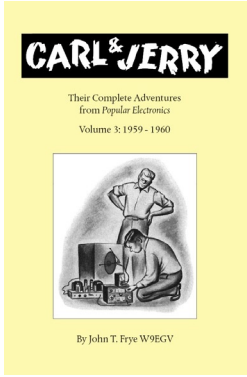

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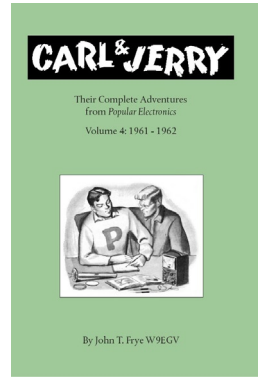

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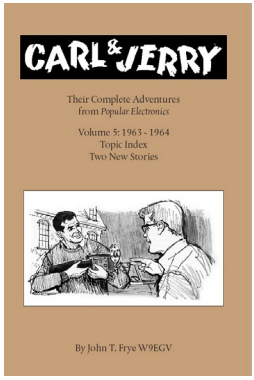

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