

NIKOLA TESLA: CREATIVE GENIUS, OR CRACKPOT?

Fascinated by the way turn-of-the-century inventor Nikola Tesla has become a worldwide cult figure, Tom Moffat has done some research into Tesla's life and achievements. He also paid a visit to the Tesla Museum in Colorado Springs, during a trip to the USA earlier this year. Here's what he found...

by TOM MOFFAT

Nikola Tesla is best known as the man who gave to the world AC (alternating current). This is a rather grand story in itself — the horrid feuds and downright sabotage between Tesla on the AC side and Thomas Edison who was promoting DC. Tesla had the Westinghouse Company backing him, and in the other corner Edison had Edison Electric.

Dirty pool was the order of the day, with Edison even kidnapping pet dogs and electrocuting them in full public view, with AC, to show how dangerous it was. (Of course he failed to point out that the job could have been done just as well with DC!) As a result of these demonstrations, it is said that the first-ever commercial application of AC was to power the electric chair at Sing Sing prison.

But the AC/DC battle was only small beans for Tesla. He (supposedly) invented a death ray, and he was certainly able to hurl enormous lightning bolts around Colorado Springs. Although he kept careful notes of these experiments, most of them 'disappeared', and Tesla was officially labelled a crackpot.

Unofficially, Tesla was responsible for some of the most startling electrical and electronic research ever carried out on this planet, or any other planet for that matter. In fact one of his biographers, Margaret Storm, thought Tesla was so clued up she was convinced he came from Venus. To celebrate this fact, her book on Tesla was printed in green ink. But just because a fellow comes from Venus is no reason to label him a crackpot.

As for Tesla's 'disappearing' research notes, papers associated with such things as the death ray project are now said to be held within a top security US government vault where they remain to this very day.

Public information about Tesla's death ray is very sketchy, but it is definitely

ment right up until the end of the Cold War.

Would it be uncharitable to think that Tesla's work from the turn of the century was the inspiration for the Star Wars particle-beam weapon? What other ideas did Tesla come up with, that might have military uses at some time in the future?

Such suggestions are usually dismissed as wild claims from unstable weirdos, but consider this: during my visits early this year to US research establishments such as Los Alamos and Sandia National Labs, some of the nation's top scientists, quite spontaneously, made special efforts to debunk the work of Nikola Tesla.

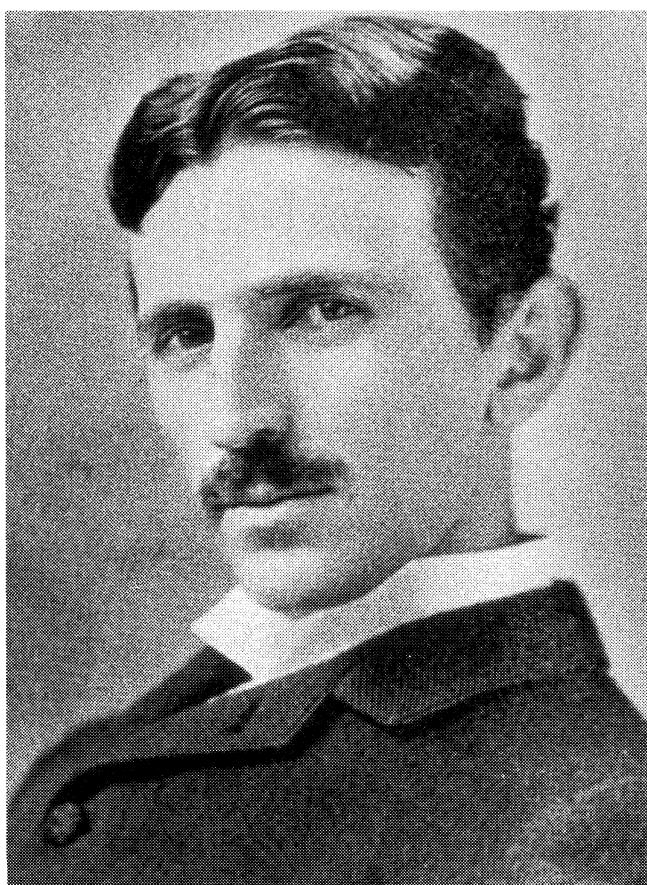
These comments came right out of the blue, in the midst of interviews about totally unrelated topics. And they didn't have any idea, at the time, that I was also researching a Tesla project for *Electronics Australia*. It is interesting to note that both Sandia and Los Alamos were reported to be right in the thick of the Star Wars research.

First seen in Bosnia

If Tesla did come from Venus, it must have been aboard a kryptonite meteor — falling in Superman style near Sarajevo in Bosnia.

At precisely midnight on July 9, 1856 there sprang forth within the hospital delivery room one screaming baby Nikola, ready and willing to change the course of life on Earth.

It took all of five years before little Nikola came up with his first invention, a waterwheel featuring a turbine without blades. This gadget later matured into a remarkable uncloggable



A picture of Tesla at the age of 38, taken from a book published in 1894 on the inventor's researches and writings. (Picture courtesy of J.L. Elkhorne.)

known that the device was based on a particle-beam principle. It just so happens that a particle-beam weapon was a main feature of the United States' 'Star Wars' program that was under develop-

pump which is now in commercial production in the USA.

I saw a working model of this pump, made of clear plastic, in the Tesla Museum in Colorado Springs. It was set up to pump water around in a circle — from the output, through plastic pipes and a valve, and back to the input. The water had been dosed with lots of styrofoam beads which flowed around with it.

If you slowly closed the valve, the water would still get past but the beads would get trapped, backing right up to within the pump itself. But when the valve was opened again, the beads, and water, all flowed smoothly. This kind of treatment would have wrecked an ordinary pump.

Tesla spent his youth gaining a successful technical education at various places in what was formerly known as Yugoslavia. He then entered the work force, even signing on for a time with the Budapest branch of the telephone company owned by his future arch-rival Thomas Edison.

In fact it was Edison's work which convinced Tesla to migrate to America. However through one of Tesla's characteristic mishaps, he lost all his money and tickets. Undaunted, he bluffed his way aboard a ship, claiming an occupied cabin was his, and a few days later he was in New York.

In a feat almost unknown back then, Tesla stepped off the migrant ship and straight into New York's high society. This wasn't so much because of his achievements, which by then were not inconsiderable, but because of his appearance and demeanor. Tesla was one snappy dresser, considered very handsome and quite the ladies' man. They were fascinated by him. (It's interesting to note that even in modern times, five out of seven Tesla biographers I have come across are women.)

Tesla was quite aware of his attraction to women, and he used it to good advantage to finance his work. At one stage he even sweet-talked the daughter of J.P. Morgan, said to be America's richest man, into handing over a few million for his research.

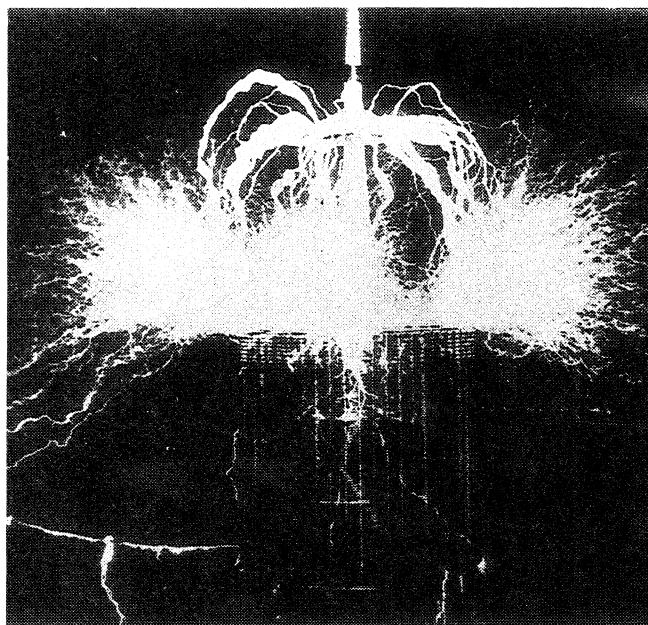
Among male friends he counted such luminaries as fellow scientist Albert Einstein and the author and humourist

Mark Twain. Some of Twain's writings suggest he was just as full of 'bulldust' as Tesla was... they would have made a good pair.

Hated skin contact

Tesla had some strange quirks in his makeup which caused his attraction to women to go totally wasted, except for the financial side. Tesla absolutely hated being touched by another person, so any woman in his company, no matter how beautiful, had to stay no closer than arm's length.

One of Tesla's closest relationships was in fact with a man, an army officer. This went on for many years and, along with his physical aversion to women, led to rumours that Tesla was homosexual.



A photo of the secondary of the Colorado Springs 'magnifying transmitter' in operation, in mid 1899. The system produced up to 12 million volts at the aerial electrode, and on starting up would produce artificial lightning reaching over 135 feet. (Courtesy of J.L. Elkhorne.)

However he found the touch of a man just as abhorrent as that of a woman, and there is every reason to believe Tesla ultimately died a virgin.

The officer's wife, like most women, was quite smitten by Tesla's charm, and she constantly arranged quiet little meetings between the two of them. Later she began sending Tesla what can only be described as love letters. Eventually it was revealed that the woman's husband, Tesla's officer friend, was aware of these goings on and what's more, he approved and even encouraged them. Looks like some good soap opera material here...

Back to Tesla's habits: like the reclusive Howard Hughes, whom Tesla

resembled in some ways, Tesla had a fetish for cleanliness. When he visited his favourite high-society restaurant in New York's Waldorf-Astoria Hotel, his table had to be furnished with exactly 18 napkins. Tesla also had an unnatural attraction to things divisible by three, hence the significance of eighteen.

There were also some powerful compulsions. Even more than being touched, Tesla loathed touching another person's hair. The smell of camphor would drive him absolutely wild. If he tore up bits of paper and put them in a dish of water, he would experience a nasty taste in his mouth. He spent his mealtimes working out the cubic content of his dishes and his food. When walking, he always counted his steps.

Tesla's senses were super-sensitive. He would hear the sound of a fly landing on a table as a dull thud in his ear. He claimed to be able to hear thunderclaps 500 miles away. And he could feel vibrations in the ground as people moved about him. Something like a carriage passing miles away would jar him terribly, and in some places he had to sleep with pads under the bed-posts to get any sleep.

So it looks like they make them different from us, on Venus. But despite his quirks — or perhaps because of them — Tesla was able to indulge in some very powerful thinking indeed, with his ideas generally backed up with working examples. However Tesla sometimes mis-fired in the publicity stakes, resulting in others getting the credit for some of his inventions.

Take, for instance, radio. We all know radio communication was invented by

Marconi. But this is wrong, according to a United States Supreme Court decision in 1943. The verdict was decided in favour of Tesla, following the discovery of some circuit diagrams Tesla made for a lecture in 1893. The 'transmitting apparatus' shows an alternator driving some tuned circuits, using symbols very similar to those we use today for circuit diagrams. This information pre-dated Marconi's work by several years.

Colorado Springs

Probably the most fascinating side of Tesla's work involved the wireless transmission of electric power.

This idea has been pooh-poohed by

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commercial interests since it was first proposed, but they did of course have a motive: if electric power could be promulgated far and wide, without wires, where would you put the electric meter? In other words, how would you charge for it?

A successful wireless power transmission scheme would thus be a disaster for existing commercial interests, who charge by the measured kilowatt-hour.

So, as with the particle-beam technology mentioned above, it is believed that details of Tesla's wireless power transmission scheme were, ah, 'submerged'. However, careful study of some of the surviving documents provides insights into what Tesla was on about.

Most of us first heard the Tesla name connected with the word 'coil'. The Tesla Coil is a classic device for generating high voltages. Basically it is a simple transformer, with a low impedance primary, and a high impedance secondary implemented as a very long piece of wire wound as a helix. A car ignition coil is an example of this type of transformer, and it can of course provide some pretty impressive sparks from a 12 volt battery.

The Tesla Coil improves efficiency, and thus the voltage generated, by making both the primary and secondary resonant at some frequency which is generated by a buzzer-type device interrupting the primary voltage to set off a string of damped oscillations.

Some experimental Tesla coils use a radio-frequency oscillator to drive the coil directly at its resonant frequency. This produces a fan-like corona discharge from the top of the coil, a pretty but not very exciting display. The older mechanical interrupter method results in big fat juicy sparks, much more satisfying.

Although I'd read about them, I had never met a Tesla coil in person until I paid a visit to the headquarters of the International Tesla Society in Colorado Springs in the USA. I was ushered into a large room in which several exhibits of Tesla's inventions were set up.

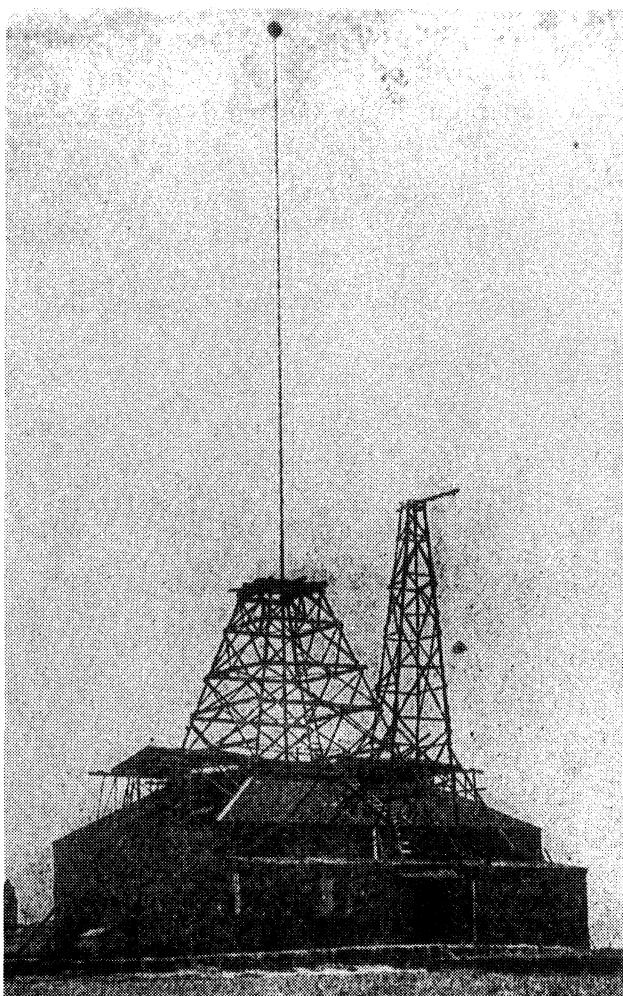
There were spark-making devices such a Leyden Jar arrangement and a Jacob's

Ladder, and on a bench a decent-sized Tesla coil of around 100 watts power.

Impressive demo

But on the floor in the centre of the room was the real showpiece — a Tesla coil standing perhaps my own height, with the secondary coil about as big around as an oil drum.

Two wires led away from the coil's base, suspended above the floor, to a big step-up transformer that had once seen



The Colorado Springs laboratory building in 1899. The primary coil was a loop 51 feet in diameter under the floor of the building. Tesla claimed to have transmitted 10kW of power to a point 26 miles away. (Courtesy J.L. Elkhorne.)

service atop a power pole. Another cable led from the pole transformer to an industrial-strength power point that had been specially installed to provide 230 volts instead of the usual American 115V.

Tesla Society President J.W. McGinnis turned off the lights and then fired up the Leyden Jar, which did lots of snapping

and sizzling and then produced nice blue sparks crawling all over its surface. Next came the table-top Tesla coil; lots of humming and snapping, and then four-inch mini lightning bolts reaching up into the air.

Then McGinnis said, "stand over against that wall, and whatever you do, don't move". Once I was safely in position, he picked up a hand-held controller at the end of a long cord, and then said, "I'm going to do a countdown now: three, two, one..." and then he hit the switch.

The big coil in the centre of the room suddenly erupted into a frenzy of wild lightning bolts, that writhed around the top of the coil and shot off about five feet in all directions. One occasionally reached up and zapped a fluorescent light fitting in the ceiling, with a resounding bang.

I was just blown away. You know those ads you see for mobile phones, featuring the little cartoon character with his jaw dropping below his chest? Well, that was me. That coil buzzed and banged and lashed the air with enormous blue whips, and the room reeked of ozone. I was mesmerised. What a show!

Meanwhile, of course, television sets several blocks away cringed in terror, mauled by enormous bursts of RF interference.

There was something deliciously antisocial about that Tesla coil — something akin to throwing a big string of firecrackers into a crowded street. Here was a device that had no other purpose for its existence other than to make a lot of noise and bad smells, and impress the hell out of people!

I later learned that this particular Tesla coil was made in 1939 to star in Hollywood movies. You know how it goes: Boris Karloff's lying there on

the operating table with electrodes attached to his head, and Frankenstein throws this big knife switch and yells "It's alive! It's alive!" and the sparks start flying, and then Boris Karloff sits up and blinks his eyes... Yeah!

A real Tesla coil!

Well now, that million-volt monster in

the Tesla Society's museum was a piddling little thing compared to the ones that Tesla himself built. On May 18, 1899, Tesla arrived in Colorado Springs for some serious experimenting, funded by the above-mentioned J.P. Morgan and his understanding daughter.

Colorado Springs was chosen for two reasons. One was Tesla's friendship with Leonard C. Curtis, of the Colorado Springs Electric Company. Tesla was going to need LOTS of power, at the right price (free).

The other reason for Colorado Springs was, in Tesla's own words, "The perfect purity of the air, the unequaled beauty of the sky, the imposing sight of the mountain range, the quiet and restfulness of the place — all around contributed to make the conditions for scientific observation ideal. To this was added the exhilarating influence of a glorious climate and a singular sharpening of the senses."

I can certainly agree with Tesla's description of the place. When I was a kid my family had a holiday cabin on the lower slopes of Pikes Peak behind Colorado Springs, and it was glorious. The weather was indeed perfect, even improved in the summer by thunderstorms that came through regular as clockwork at 4pm every afternoon to cool the place down. Otherwise the air was very dry — an ideal insulator for high-voltage experiments.

Tesla established his temporary home in room 207 (divisible by three) in the Alta Vista Hotel, and set up his lab in an open field, one mile from the city and at an elevation of 6000 feet.

Lab is long gone

Ninety-five years later the lab is long gone, but I thought it would be interesting to try to find the site anyhow. Tesla described the site as 'near the School for the Blind and Deaf', and since that still exists, that got me fairly close. The Tesla Society pinned it down even further, although with two different versions.

One version put the lab site in the city's Memorial Park. The park is not a memorial to Tesla, but to firemen all over the USA who have died in the line of duty. There is however a small sign

commemorating Tesla's activities 'on this site...'

The Tesla Society said the sign was somewhat misplaced, and to get to the exact spot it was necessary to walk something like '60 paces west and then 40 paces south'. This I did, and then I got my daughter Fiona to take a photograph of me standing exactly on that magic spot. Tesla's beloved 'imposing sight of the mountain range', Pikes Peak, is in the background.



Tesla planned to transmit news broadcasts, time and navigation signals and other information as well as power, from the Wardenclyffe site on the east coast of America. Copper sheeting was never added to the hemispherical electrode as the tower was razed during World War 1. (Courtesy J.L. Elkhorne.)

The other version locates the lab at '22 Foote Street', possibly because this house has been advertised for sale several times as the site of Nikola Tesla's lab.

The sign in Memorial Park is quite near the end of Foote street, and 30 seconds' walking along it puts you right in front of number 22. So the two sites are really close together — perhaps within 150 metres or so.

Receiving apparatus

It was at this lab that Tesla was able to hear thunderstorms '500 miles distant'. He had built a receiving apparatus which would respond to the lightning, and then he'd step outside an hour later to listen for the bang...

He eventually began tracking the

regular 4pm thunderstorms, from their origins around Pikes Peak until they headed out east along the plains. And from these experiments came the biggest "Eureka!" of Tesla's career.

He noted that as the storms moved further away, his electromagnetic pulse detector declined in output, as expected. But once the storms got to a certain distance, the intensity began increasing again, and at twice that distance the readings again decreased. He saw this as

a cyclic variation of electromagnetic intensity with distance, and deduced that it was caused by some resonance within the earth itself. What Tesla was of course observing were standing waves — or as he came to call them, stationary waves. He thus saw the earth as a big 'metal ball', which could conduct electricity as easily as any wire.

All Tesla needed to do to transmit his own electricity was to somehow couple energy from the power generator into the 'resonant earth'. And, of course, a Tesla Coil was chosen to do the job. But this time he came up with an enhanced design using a tertiary coil linked to the secondary coil, with the whole works resonant at 50kHz. This became known as his 'magnifying transmitter'. Perhaps in recognition of what was to come, Tesla adorned the door of his lab with a sign: 'Abandon hope all ye who enter here' — from Dante's *Inferno*.

The completed magnifying transmitter stood over 200 feet high, a building that looked somewhat like a fat bell-tower with a big metal mast topped by a large copper ball. Tesla reckoned it would be capable of generating 100 million volts. During initial tests the magnifying transmitter did sling some rather impressive lightning bolts, and it caused flashovers in lightning arresters of buildings 12 miles away!

Full power test

Eventually it was time to test the magnifying transmitter at full power. To mark the occasion, Tesla dressed in his Sunday best. He arrived at his lab full of apprehension; electricity had never before been applied in the quantities he intended to use. What would happen? Would the magnifying transmitter ex-

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plode, or simply melt down? Would Tesla be barbecued, or even vapourised?

To observe the full result of the test, Tesla wanted to watch the big secondary coil within the building, as well as the copper ball on top of the tower. So he decided to stand near the door where he could see both, and get an assistant, Kolman Czito, to throw the switch on his command — closing it for exactly one second, and then open it. With both men in position, Tesla took a deep breath and yelled "NOW!"

Here it helps to visualise that scene in Frankenstein's lab, with the Doctor watching closely as his assistant Igor grips the big knife switch and rams it home. For Tesla, sparks sizzled around the secondary coil while big fat arcs snaked around the overhead ball.

Well, so far so good, and nothing blew up. So for the next test, Tesla told Czito to close the switch and leave it closed until Tesla ordered it open again. Tesla moved further outside, where he could view the entire mast and ball. Then he yelled, "NOW! CLOSE THE SWITCH!" (It's alive! It's alive!)

It seemed that the longer the switch was closed, the more energy built up in the system, and soon bolts of fire were surging through the coils and the ground beneath the station was shaking. Outside, lightning bolts shot 135 feet from the copper ball and the resulting thunder claps were heard in the gold mining town of Cripple Creek, up in the mountains 15 miles away.

By now Czito was starting to panic; no order to open the switch had been forthcoming. Maybe the boss was lying outside, a pile of smoking bones. Actually Tesla was standing outside in his greatest moment of glory, revelling in the fireworks display. But suddenly everything went dead.

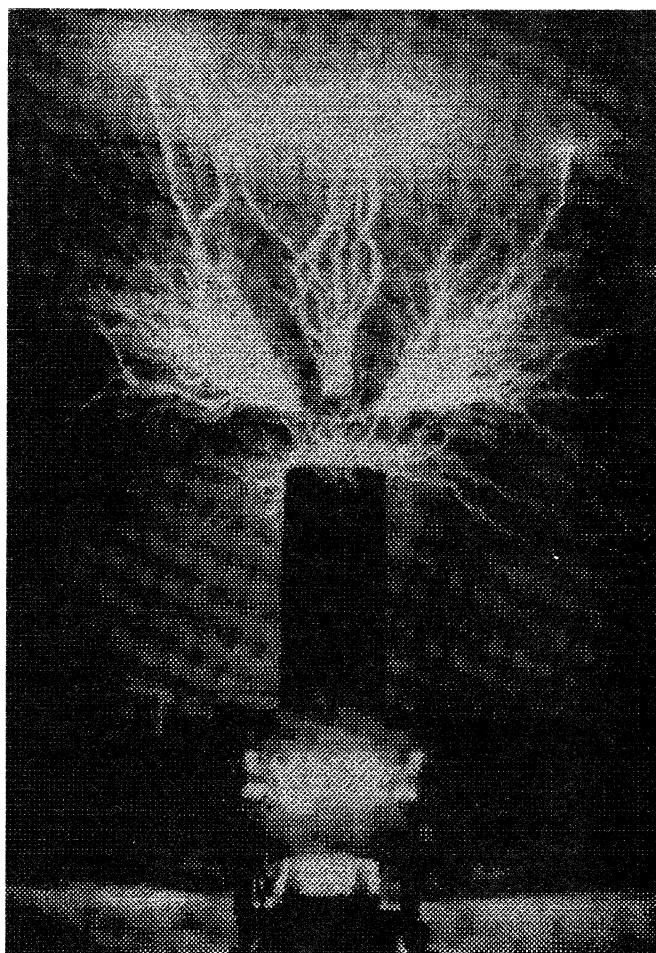
"What did you do that for?", Tesla belched, "I told you to leave the switch on until I ordered it off!"

But Czito had not touched the switch. Instead the power had failed. When Tesla rang the Colorado Springs Electric Company to complain, he was told that

the power station's generator was on fire and the whole city had been blacked out. Soon a standby generator was brought on line, along with the lights of Colorado Springs. But Tesla's power feed had been 'isolated'.

When he pleaded to be re-connected so he could continue his experiments, he was told — firmly — no. Relations with the power company were finally restored when Tesla volunteered to have the burnt-out generator repaired at his own expense.

Further experiments were somewhat



Tom captured this view of the million-volt Tesla coil operating at the Tesla Museum in Colorado Springs, when he visited there earlier this year.

more controlled, with Tesla tuning and tweaking his magnifying transmitter to minimise the sparking and maximise the amount of energy transferred into the earth, which was the intention in the first place.

As an analogy of how Tesla saw this working, consider the earth as a partially inflated soccer ball. If you take a finger and prod the soccer ball anywhere on its surface, you will feel the result as in-

creased pressure. And the pressure felt would be the same anywhere on the ball you care to place your hand. Electricity 'prodded into the earth' at Colorado Springs should be recoverable at the same strength anywhere on the earth's surface, regardless of how far it is from the transmitter.

Experts in power transmission said there was no possibility at all that Tesla could have transmitted wireless power. But documents do reveal that Tesla set up an experimental power receiving device in a house at Castle Rock, about

60km up the road toward Denver. And when he turned on his magnifying transmitter back in Colorado Springs, enough power was recovered to light the entire Castle Rock house.

How do the experts explain that one?

Multipurpose station

Tesla also had plans to modulate his magnifying transmitter with both data and audio signals, and even a time and frequency standard. He proposed a system in which radio signals could be broadcast simultaneously to the whole world, instead of just from point to point. This was, of course, the first inkling of the international broadcasting we have on shortwave today.

Tesla's plan was to build an enormous magnifying transmitter at Wardenclyffe, on America's east coast, to bridge the Atlantic with a collection of broadcast, Morse code and telegraph services, and a fair measure of electric power to boot. This service was to be made into a commercial operation known as the World System.

But the project was never completed because the financier J.P. Morgan, who had backed previous projects, pulled the plug on Tesla. Maybe Tesla had at long last had a falling out with Morgan's daughter. That blow was really the end of Tesla's long and fruitful career.

Tesla survived for another 40 years before dying, at age 86, in 1943. Upon his death the United States government confiscated all of Tesla's papers and research notes.

Some of the material later turned up in a museum in Belgrade near Tesla's birthplace, but the most significant papers remain, to this day, where...?

Tesla today

More than 50 years after his death, Nikola Tesla has become a kind of cult figure. His unusual ideas have attracted other people with unusual ideas, and they have grouped together under the banner of the International Tesla Society, based in Colorado Springs (PO Box 5636, Colorado Springs, CO 80931, USA).

Now, contact with these people might be a little, er, off-putting in the first instance. When I arrived at their headquarters, I was first greeted by a display of materials concerning New-Age stuff...pyramids, crystals, UFO's, miracle cancer cures, anti-gravity devices, perpetual motion, etc. Whether or not they deserve it, these matters have taken on a kind of mystical character, almost as if they constitute a religion. Practitioners of these things are routinely debunked and ridiculed, although one wonders if the detractors simply fear the promoters might be right.

Anyhow, Nikola Tesla, like it or not, has been sucked into this scene, and his followers are thus tarred with the same brush. One suspects that governments find this a convenient state of affairs, since debunking Teslaism (new word there...) seems to be a prominent government pastime.

The Tesla Society has also got itself involved with a shortwave radio station called WWCR (World Wide Christian Radio), which seems to have become the primary voice of American dissidents. The society's weekly program 'Extraordinary Science Radio Hour' features their president, J.W. McGinnis, interviewing people about such things as optical computers, fluoride in drinking water, super-steam power, and making gold at home. When I was in the USA I listened to a couple of these programs and found them well-produced and interesting — despite their transmission on what's been described as 'Crackpot Radio'.

The Extraordinary Science Radio Hour is aired on Sundays at 11pm American Eastern Standard time. This translates to mid-afternoon in Australia, and on the station's frequency of 5065kHz it's unlikely you'll hear much. WWCR does come through well in the late afternoon/early evening, by which time it's pretty heavily into fundamentalist religion.

There was a more detailed discussion



Author Tom Moffat pictured standing at the exact site(?) of Tesla's magnifying transmitter installation in Colorado Springs. Visible in the background is the snow covered Pikes Peak Mountain, which apparently inspired Tesla's ideas.

of this fascinating station in my Spectrum column, in *Electronics Australia* for July 1995.

Here we have only scratched the surface of all the wonderful things Nikola Tesla was up to. What we didn't talk about was his excursions into fields such as radar, Kirlian photography, vertical takeoff and landing aircraft, and sophisticated remote control systems.

There will most likely be those who think we've already gone too far with Tesla, of course.

I can visualise in Letters to the Editor. "How dare you let Moffat write that rubbish in a serious electronics magazine!" But think about it — with all this interest in Tesla in the past 100 years, there must be some truth in there somewhere. ♦