

ELECTROCULTURE

THE GARDEN REVOLUTION



*Electroculture: Its History, Its Promise, and the
Truth About Whether It Works*

REV. GEORGE H. STODDARD

BOOKLYN

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First edition, 2026.

“Canst thou send forth lightnings, that they may go, And say unto thee, Here we are?”

— Job 38:35 (ASV)

About This Book

For nearly three hundred years, people have tried to grow more food with electricity. A copper coil on a wooden stake is only the latest chapter.

The Garden Revolution tells the whole story of electroculture: the Edinburgh myrtle trees of 1746, the French priest who built a mast to pull electricity from the sky, the Finnish physicist who strung wires over barley after studying the northern lights, the British government committee that tested it for eighteen years, and the Chinese greenhouses running at fifty thousand volts today.

It answers the questions gardeners actually ask. When did electroculture start? Who started it, and why? Was it hidden or suppressed by the fertilizer industry? And does it work?

The answers are honest ones. Some forms of electroculture have real experimental support. Others have none. This book separates them, shows the evidence for each, explains the physics in plain language, and then gives you a step-by-step method to test electroculture fairly in your own garden.

Includes a full timeline, glossary, safety guidance, and sources.

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PART ONE

The Spark

1746 – 1800

CHAPTER ONE

The Question in the Garden

Somewhere tonight a gardener is winding copper wire around a wooden dowel. She saw a video. In it, a tomato plant beside a copper spiral stood a foot taller than its neighbor, and a confident voice explained that this was electroculture: an ancient, free, suppressed way of feeding plants with the energy of the sky. No fertilizer. No pesticide. Just wire, wood, and the atmosphere.

She will push the dowel into her raised bed and wait. And whether or not her tomatoes do better this year, she has joined one of the longest-running experiments in the history of agriculture, an experiment that began almost three centuries ago, drew in clergymen, physicists, a knight of the realm and at least three governments, and has never quite been finished.

This book is about that experiment. It asks the four questions every curious gardener eventually asks. When did electroculture start? Who started it, and why? Has it been hidden? And the one that matters most at planting time: does it work?

Three things wearing one name

Most arguments about electroculture go wrong in the first sentence, because the word covers three different things. Keeping them apart is the most useful habit this book can give you.

- *Powered electroculture.* A machine or power supply creates a strong electric field over the crop, usually from a network of thin wires overhead charged to tens of thousands of volts, or drives a small current through the soil or growing medium. This is what Lemström, Lodge, Blackman, the British government and modern Chinese greenhouses did. It uses real, measured, supplied electricity.

- *Galvanic electroculture.* Two different metals, classically copper and zinc, are buried in moist soil and joined by a wire. The soil acts as the electrolyte of a weak battery, and a small real current flows. This is the “earth battery” of the 1840s.
- *Passive electroculture.* A mast, coil, pyramid or spiral, connected to no power source at all, is said to “harvest” atmospheric electricity or other energies and deliver them to the plants. This is Bertholon’s device of 1783, Christofleau’s apparatus of the 1920s, and the copper coil of today’s social media.

These three have different physics, different histories and, as we will see, very different evidence behind them. A study showing that fifty thousand volts over a greenhouse raises lettuce yields tells you nothing about a coil on a stick. Nearly every overheated claim about electroculture, for it or against it, comes from taking evidence about one kind and spending it on another.

What kind of book this is

I am a minister, not a physicist, and I came to this subject the way most people do: because someone I trust told me it worked, and someone else I trust told me it was nonsense. I have tried to do what Scripture tells us to do with any claim: “prove all things; hold fast that which is good” (1 Thessalonians 5:21, ASV).

So this book makes you three promises. Where the historical record is solid, I will tell you what it says. Where a claim rests on one man’s word or on a story repeated without a source, I will say so. And where the honest answer is “nobody knows yet,” I will not dress it up as anything else.

That means some readers will be disappointed. If you want to be told that a copper coil will double your harvest and that the fertilizer companies buried the secret, this book will not tell you that, because the evidence does not. If you want to be told that the whole thing is superstition, this book will not tell you that either, because plants are electrical creatures living in an electrical atmosphere, and some forms of electroculture have real experimental support.

The truth is more interesting than either story. Let us begin where it began: in Edinburgh, in the autumn of 1746, with two myrtle trees.

CHAPTER TWO

The Electric Century

In the 1740s electricity was the most exciting thing in the world. The friction machine, a glass globe spun against a hand or a leather pad, could now produce sparks on demand. In 1745 and 1746 the Leyden jar arrived, the first device that could store a charge, and suddenly a line of monks or soldiers holding hands could be made to jump in unison. Electricity was a parlor entertainment and a philosophical mystery at once, and natural philosophers pointed it at everything they could reach: water, metals, animals, the sick, and the dead.

It was only a matter of time before someone pointed it at a plant.

Maimbray's myrtles

The man usually given credit is a Dr. Maimbray (the name is also spelled Mainbray) of Edinburgh. In the autumn of 1746 he electrified two myrtle trees through the month of October and reported that they put out new shoots and buds, at a season when neighboring myrtles left alone did not. The report was brief. It had no measurements worth the name, no repeated trials, and two plants. But it was published and talked about, and it started something.

Within a year or two the experiment was being repeated across Europe. The most important of those who repeated it was a French clergyman.

The Abbé Nollet

Jean-Antoine Nollet was the leading electrical experimenter in France, a priest of the Church, a member of the Royal Academy of Sciences, and the man who taught physics to the royal family. He was also careful, by the standards of the day. He sowed seeds, mustard among them, in matching metal pots, kept the pots side by side, and electrified one set for hours each day while leaving the other alone. The electrified seeds, he reported, sprouted sooner and grew faster in their first days.

Nollet was cautious about what this meant. He noticed that electrified bodies lose moisture faster, and he suspected that electricity was speeding the movement of fluids through the plant rather than adding some new principle of life. That guess, that an electric field changes how water and dissolved substances move, is still one of the leading explanations offered today.

Others reported the same thing: Jean Jallabert in Geneva, Georg Matthias Bose in Wittenberg, and experimenters in Italy and England. By about 1750 it was widely accepted among electricians that electricity quickened vegetation.

What these experiments were, and were not

It is worth being exact about what the first electroculturists did, because their work is often cited today as proof of something it never tested.

They used powered electricity, generated by a machine, applied directly to a potted plant for hours at a time. They did not use antennas, coils or the atmosphere. Their samples were tiny, a pot or two. There was no randomization, no statistics, and little control over the things that actually govern seedling growth: warmth, light, and water. An electrified pot sitting near a busy experimenter and his machine is not in the same conditions as a pot left in the corner.

So the fair summary of the 1740s is this. Several competent men independently reported that strong static electrification speeds germination and early growth. Their methods could not rule out ordinary explanations. They had raised a real question and had not answered it.

One generation later a second French priest took the question out of the laboratory and into the garden, and in doing so invented the idea that still

drives electroculture today: that the electricity plants need is already in the sky, free for the taking.

CHAPTER THREE

Bertholon and the Electro-Vegetometer

Pierre Bertholon de Saint-Lazare was a priest of the Lazarist order and a professor of experimental physics at Montpellier. He was a friend and correspondent of Benjamin Franklin, and an energetic promoter of Franklin's lightning rod in France. He wrote on the electricity of meteors, the electricity of the human body in health and disease, and, in 1783, on the electricity of plants.

De l'électricité des végétaux is the founding document of electroculture. It is where the scattered pot experiments of the 1740s become a program for agriculture.

The argument from the weather

Bertholon's reasoning went like this. Franklin had shown in 1752 that lightning is electricity and that the atmosphere is electrified. Farmers had always said that crops grow best in thundery weather and that rain from a thunderstorm does more good than water from a well. The laboratory had shown that electricity quickens plants. Therefore, Bertholon concluded, atmospheric electricity is a natural fertilizer, one of the ordinary means by which the Creator feeds the fields, and an ingenious man might gather more of it and bring it down to his garden.

It was a beautiful argument. Parts of it were even right. Thunderstorms do fertilize the earth: lightning forces nitrogen and oxygen in the air to combine, and the rain washes the resulting nitrates into the soil. But that is chemistry, not a direct electrical feeding of the plant, and no mast in a garden can imitate it. Bertholon could not have known this; nitrogen had been

identified only eleven years earlier.

The machine

His device, the *électro-végétomètre*, was a tall mast set in the garden. At its top was an insulated metal arm carrying sharp points, to draw electricity from the air as a lightning rod does. A conductor led down to a second set of points held over the plants, where the collected electricity was supposed to shower down onto the beds. The arm could be swung to carry the influence over different parts of the garden.

Bertholon also proposed watering with electrified water, the gardener standing on an insulated cart connected to a machine, and suggested electricity as a remedy for insect pests and plant diseases. He reported that his electrified plots flourished.

The first passive device

Notice what had changed. Nollet's electricity came from a machine and could be measured, crudely, by the length of its spark. Bertholon's came from the sky, with no way to say how much of it there was or whether any of it reached the plant. His electro-vegetometer is the direct ancestor of every antenna, spiral and coil sold to gardeners since. And it shares their central weakness: it offers a mechanism that sounds reasonable and results reported by the inventor, with nothing in between that an outsider can measure.

Bertholon's book was widely read and translated. For a few years electrified gardening was fashionable. Then a better experimenter looked into it, and the fashion ended.

CHAPTER FOUR

The First Skeptic

Jan Ingenhousz was a Dutch physician, court doctor to the Empress Maria Theresa, and one of the finest experimentalists of the century. In 1779 he had discovered something far more important about plants than anything electricity would ever show: that green leaves, in sunlight, purify the air, and that they do the opposite in the dark. He had found photosynthesis.

Ingenhousz was also an expert electrician, a friend of Franklin, and he had no prejudice against electroculture. He simply tried it properly.

The experiment done right

In the 1780s he raised sets of seedlings side by side under conditions as nearly equal as he could make them. Some he electrified strongly, for long periods. Some he left alone. Some he shielded from any atmospheric electricity. He repeated the trials. He found no difference.

Then he did something more valuable still: he worked out why the others had been fooled. A plant under experiment gets attention. It is moved to a convenient place, often nearer the window; it is watered on schedule; it is watched. Above all, Ingenhousz argued, it gets more light, and he knew better than any man alive what light does to a plant. The enthusiasts had not controlled for the one factor that mattered most, because they had not known it mattered.

He published his conclusion plainly: the supposed effect of electricity on vegetation was an error.

The pattern is set

Bertholon's supporters replied; other experimenters took sides. But Ingenhousz's reputation was great, his method was better, and by 1800 learned opinion had swung against electroculture. The subject went quiet for forty years.

It is worth pausing here, because the next two centuries repeat this first half-century almost exactly:

- An enthusiast reports striking results from a few plants.
- The idea spreads quickly, carried by its promise of free abundance.
- A careful experimenter with proper controls finds little or nothing.
- Interest collapses, and a generation later someone begins again, usually unaware of how the last round ended.

This cycle is the single most important fact in the history of electroculture. When people say the knowledge was "lost" or "hidden," what they are noticing is real: the subject does keep disappearing. But it disappears each time for the same recorded reason. It is not that someone locks it away. It is that the results will not hold still.

That does not mean Ingenhousz had the last word. He tested static electricity from a machine on seedlings in pots. He did not test sustained high-voltage fields over a field crop through a whole season, because no one could yet build such a thing. When men finally could, the results would be harder to dismiss.

PART TWO

Wires in the Field

1840 – 1914

CHAPTER FIVE

The Scottish Barley Craze

By the 1840s electricity had changed. Volta's battery had given the world steady current. Faraday had shown how magnetism and electricity produce each other. The telegraph was being strung along the railways. Electricity was no longer a spark from a glass globe; it was a force that flowed in wires and did work. And agriculture was changing too: Justus von Liebig had just published his chemistry of plant nutrition, and farmers were hungry for scientific improvement.

Into this moment came a Scottish landowner with a field of barley.

Forster of Findrassie

In 1844 Robert Forster, of Findrassie near Elgin in the north of Scotland, laid out a plot of barley with wires. As the accounts describe it, he buried a wire around the edge of the plot, set poles at the ends on a north–south line, and ran an elevated wire between them joined to the buried one, the idea being to collect atmospheric electricity and lead it through the soil. He reported a barley crop far heavier than that of the surrounding land.

The news ran through the farming press of Britain. Here was a way to raise yields for the price of some wire and a few poles. Through the winter of 1844–45 landowners all over the country prepared plots for the coming season.

The earth battery

At about the same time, across the Atlantic, a William Ross of New York reported on a different method. He buried a sheet of copper at one end of a row of potatoes and a sheet of zinc at the other, and joined the two above ground with a wire. Copper and zinc in moist earth form a weak battery, so a small current really did flow through the soil of the row. Ross reported potatoes several times the size of those in his untreated rows.

This was the first galvanic electroculture, and unlike Forster's arrangement it involved an actual, if tiny, current. It was also the first electrocultural experiment in which something besides electricity was plainly going on. Zinc and copper are both plant micronutrients, and both dissolve slowly from buried metal. A plot with zinc and copper plates in it is not the same as a plot without them, even if no wire connects them. Nobody in 1844 thought to bury unconnected plates as a control.

1845: the test and the collapse

The season of 1845 was the first mass trial of electroculture, and it went badly for the idea. Dozens of careful gentlemen copied Forster's arrangement, and most saw nothing. Edward Solly, a chemist working with the Horticultural Society of London, gathered and ran a large series of trials and reported the outcome in the Society's journal: by his count only a minority showed any benefit, almost as many showed harm, and the rest showed no difference at all. That is the pattern chance produces.

By 1846 the craze was over. The agricultural journals moved on to guano and superphosphate, fertilizers whose effects any farmer could see for himself every time.

What the craze teaches

The barley craze deserves more attention than it gets, because it is the cleanest natural experiment in the history of the passive method. A single striking success was reported. Many independent people tried to reproduce it within one year, with every motive to succeed. It did not reproduce. No company, government or cartel was involved in its failure. Farmers simply stopped doing a thing that did not pay.

The method that was abandoned in 1846, an unpowered wire on poles connected to a wire in the ground, is in every essential the method being sold again today.

CHAPTER SIX

Grandeau's Cage

If you cannot be sure how much atmospheric electricity a mast adds, there is another way to ask the question. Take the atmospheric electricity away, and see whether the plant suffers.

That was the idea of Louis Grandeau, one of the leading French agricultural chemists of his day and director of the agricultural station at Nancy. In the 1870s he grew matched plants, tobacco, maize and wheat among them, in the open air and under cages of fine wire netting. A grounded metal cage shields its interior from the electric field of the atmosphere. Whatever the sky was doing electrically, the caged plants would feel none of it.

A striking result

Grandeau reported that the caged plants did dramatically worse. They were smaller, and they produced something like half the dry matter, flower and seed of the plants left open to the sky. He concluded that atmospheric electricity was a major factor in plant growth, perhaps as necessary as rain. Other French experimenters reported similar results, and Grandeau's standing ensured that the finding was taken seriously across Europe.

And a striking weakness

The objection was raised almost at once. A wire cage does more than block an electric field. It casts shade. It breaks the wind, traps humid air, changes the temperature, and intercepts dew. Each of those affects growth, and shade most of all. Critics who repeated the work with cages of coarser mesh, or who compared metal cages with matching cages of non-conducting thread, generally found the difference shrinking or vanishing.

The experiment has been repeated on and off ever since without a settled result. That in itself tells us something. If the fair-weather electric field were as vital to plants as Grandeau believed, crops would fail in greenhouses with metal frames and thrive beside them in the open, and they do not.

Why it mattered anyway

Grandeau's cage did not prove what he thought it proved, but it changed the standing of the subject. For the first time a scientist of the first rank, at an official research station, had published quantitative evidence that atmospheric electricity matters to crops. Electroculture was no longer only the hobby of clergymen and country gentlemen. It was a question for laboratories.

And in a laboratory in the far north of Europe, a physicist who had spent his life studying the electricity of the polar sky was about to give the subject its first real method.

CHAPTER SEVEN

Lemström and the Northern Lights

Karl Selim Lemström was professor of physics at the University of Helsinki, and his subject was the aurora. He led expeditions to Lapland and to Spitsbergen to study it. He believed, as many then did, that the northern lights were an electrical discharge from the earth to the upper air, and on mountaintops in Lapland he set up networks of pointed wires to try to produce an artificial auroral glow.

While he was in the Arctic he noticed the plants.

The observation

Vegetation in the far north has only a few weeks of summer, yet it grows with astonishing speed and vigor. Rye and barley ripen in a season too short, by southern reckoning, to ripen anything. The usual explanation is the long daylight of the polar summer, and that explanation is correct. But Lemström was struck by something else. Studying the growth rings of northern pines, he believed he saw the wide rings fall in years of strong auroras and sunspot maxima. And he observed that the needles of conifers and the awns of barley are sharp points, the very shape an electrician uses to draw current from the air.

His conclusion was that the high-latitude atmosphere, with its strong electrical currents, was feeding the plants through their points. He set out to test it.

The method

Beginning in 1885, Lemström did what no one before him had done. Over a plot of crops he stretched a network of thin wires on insulated posts, with short metal points hanging down toward the plants. He connected the network to one pole of an influence machine, a large static generator, and the other pole to a plate buried in the earth. The crop now stood in a steady, artificially maintained electric field many times stronger than nature's, with a minute current passing from the points through the air to the plants and the ground.

This is the overhead-discharge system. In its essentials it is the method the British government would test thirty years later, and the method running in Chinese greenhouses today. Lemström invented it.

The results

He ran trials for years, first in Finland, then with collaborators in Burgundy, in Germany, and in England at the Durham College of Science in Newcastle. He tested cereals, root crops, strawberries, beans and more. He reported increases for most crops, commonly in the range of a third to a half more than the unelectrified control, along with earlier ripening and sweeter fruit.

He also reported something that later workers would confirm and that gives his account the ring of honest observation: the treatment could do harm. Applied in strong sunshine and heat, it damaged the crop. On dry soil without irrigation it reduced the yield. Some plants, such as cabbages and turnips, did not respond or responded badly unless well watered. An inventor merely selling a wonder does not usually list the ways it fails.

The book

In 1904, the year of his death, his results appeared in English as *Electricity in Agriculture and Horticulture*. It is short and clearly written, and it is in the public domain, free to read today in online libraries. It is the first place a serious student of electroculture should go.

Lemström's weaknesses were those of his time. His plots were small and seldom replicated. Control and treated plots sat side by side without the

randomization that guards against a good strip of soil. A hand-turned or motor-driven static machine was unreliable in damp weather, exactly when crops were growing. But he had turned electroculture from an anecdote into a specified, repeatable procedure. Anyone could now build his apparatus and check.

In England, a famous physicist and a practical farmer decided to do so.

CHAPTER EIGHT

Lodge, Newman, and Evesham

Sir Oliver Lodge was one of the most celebrated physicists in Britain, a pioneer of radio, principal of the University of Birmingham, and a man with a gift for making electrical machinery work. J. E. Newman was a practical agriculturist in the fruit-and-vegetable country of the Vale of Evesham. Around 1906 the two men, with the grower R. Bomford, set out to do Lemström's experiment on a commercial scale.

Solving the machine problem

Lemström's influence machine was the weak point. Lodge replaced it. He used an induction coil to step ordinary current up to a very high voltage, and his own mercury-vapor valves to rectify it, so that the overhead wires received a steady charge of one sign. The wires were raised high enough, some fifteen feet, for horses and wagons to work beneath them. The system could now be switched on in any weather and run for hours daily across many acres.

The Lodge–Newman installation was, for its day, serious engineering: a powered line at tens of thousands of volts over roughly twenty acres of farmland. It was nothing like a coil in a flowerpot.

The wheat

In the first seasons the results looked excellent. Wheat under the wires was reported to yield roughly thirty to forty percent more grain than the control area, and millers reportedly judged the electrified grain of better baking quality. Strawberries and other crops were also said to benefit. The reports were published, Lodge lectured on them, and a company, the Agricultural Electric Discharge Company, was formed to sell the apparatus. Installations were tried in Britain and abroad.

Dumfries

One of the most persistent experimenters was a Scottish landowner, Miss E. C. Dudgeon of Lincluden, near Dumfries. From 1911 she ran overhead-discharge trials on potatoes and then on oats, keeping records season after season, and she reported substantial increases in several years, including a large gain in oats in 1916. Her field at Lincluden would become one of the official government test sites.

The doubts

Even at the height of the enthusiasm there were reasons for caution, and the more careful workers stated them. In 1914 two scientists at the University of Leeds, Ingvar Jørgensen and J. H. Priestley, reviewed the field. They pointed out a problem that had been hiding in every overhead-wire experiment: the electric discharge does not stay over the treated plot. The wind carries the charged air sideways, sometimes a long way. A “control” plot beside the electrified one may be receiving a share of the treatment. Controls placed too near would hide a real effect; controls placed far away were on different soil.

There was also the plain matter of plot design. The Evesham comparison set one large treated area against one large untreated area. However big the fields, that is a sample of one. If the treated field happened to be better land, the electricity would get the credit.

So by 1914 the position was this. A powered method existed. Reputable people on several farms had reported gains of twenty to fifty percent. But the trials were unreplicated, the controls were doubtful, and nobody could

explain the effect.

Then the war came. German submarines began sinking the ships that carried Britain's wheat, the country came within weeks of running short of bread, and anything that might raise the home harvest by a third became a matter of national survival. The government decided to find out, properly and at public expense, whether electroculture was real.

PART THREE

The Great Trial

1914 – 1936

CHAPTER NINE

Blackman's Numbers

The man chosen to find out was Vernon Herbert Blackman, professor of plant physiology at Imperial College in London. Blackman was no enthusiast. He was a specialist in the measurement of plant growth, the author of the “compound interest law” that still appears in textbooks, and he approached electroculture as a problem in measurement.

The field trials

From 1917 Blackman and his colleagues ran overhead-discharge trials on field crops at several sites: Miss Dudgeon's land at Lincluden, the Rothamsted Experimental Station in Hertfordshire, and Harper Adams Agricultural College in Shropshire. Thin wires were strung about seven feet above the crop and charged to several tens of thousands of volts. The current that actually passed down through the air to the crop was tiny, on the order of a milliampere or less for a whole acre. The discharge was run for some hours a day through the early part of the growing season.

The crops were mainly spring-sown cereals: oats, barley and wheat. Controls were set at a distance to avoid drift, and in some seasons were themselves surrounded by earthed wire screens.

In 1924 Blackman published the summary in the *Journal of Agricultural Science*. Over six years he counted eighteen field experiments. Fourteen showed an increase in favor of the electrified crop. Four showed a decrease. The average result across all eighteen was an increase of about twenty-two percent.

The laboratory

Blackman knew that field plots are noisy, so he also took the question indoors. In pot cultures under glass, where soil and water could be made uniform, electrified cereals again tended to outyield the controls.

Then, with A. T. Legg and F. G. Gregory, he reduced the experiment to its simplest form: single barley seedlings in the dark, a charged point above each one, and a microscope to measure the growth of the young shoot hour by hour. A current almost too small to measure, around a ten-billionth of an ampere, produced a small but real acceleration of growth. Stranger still, the faster growth went on for some hours after the current was switched off. That paper was published in 1923 by the Royal Society.

What Blackman established

This is the high-water mark of the evidence for electroculture, and it deserves to be stated carefully.

A first-rank plant physiologist, with no commercial interest, using the best methods of his day, at official research stations, found that a high-voltage overhead discharge increased the yield of spring cereals in most trials, by about a fifth on average, and showed a corresponding effect on single seedlings under laboratory control.

It also deserves its limits stated carefully. Fourteen out of eighteen is suggestive, not conclusive, and the field plots were still not replicated and randomized in the way that would soon become standard. The effect swung widely from year to year: a large gain one season, a loss the next, on the same land with the same equipment. And a twenty percent increase, if real, could also be had from a bag of sulfate of ammonia, without poles, wires, insulators, a generator, and a man to mind them.

Those two problems, the inconsistency and the cost, would decide the matter.

CHAPTER TEN

The Electro-Culture Committee

In 1918 the Board of Agriculture and Fisheries, under its president Rowland Prothero, later Lord Ernle, appointed an Electro-Culture Committee. Its chairman was Sir John Snell, soon to be head of the Electricity Commission and the country's senior electrical engineer. Blackman was its leading scientific member. Its task was to settle by experiment whether electrical treatment could raise the national harvest.

No other government had done or has done anything quite like it. For eighteen years a standing official committee, with public money, engineers, physiologists and experimental farms, tested electroculture.

Eighteen years

The work fell into two streams. Field trials continued at Rothamsted, Harper Adams, Lincluden and elsewhere. Pot-culture and laboratory work, increasingly the larger part, was carried on at Rothamsted and at Imperial College. The Committee reported to the Ministry each year in a series of Interim Reports.

The early reports were encouraging, and they are the source of Blackman's published figures. Pot cultures of barley, oats and maize continued through the 1920s to show increases under discharge more often than not. The Committee tested different voltages, currents, times of day and stages of growth, looking for the conditions that would make the effect dependable. It learned some things: that very small currents did as well as larger ones, that excessive discharge did harm, that treatment in the first weeks mattered most.

What it never learned was how to make the effect reliable. Good seasons were followed by null ones. Through the early 1930s, as trial design improved

and replication increased, the measured gains grew smaller and less consistent. This is the usual fate of a small or fragile effect when experiments become more rigorous, and it is also the usual fate of an effect that was never there. The Committee's data cannot tell us which.

The end

In 1936 the Committee recommended its own dissolution. Its final report said there was "little advantage to continue the work either on economic or on scientific grounds," and expressed regret "that after so exhaustive a study of this matter the practical results should be so disappointing." The eighteenth and last Interim Report was issued in February 1937.

The reports nobody read

Here we reach the one episode in this history that gives real substance to the feeling that electroculture was hidden.

The Committee's reports were not published in the ordinary way. According to the historian David Kinahan, who studied the Committee's papers for a dissertation in 2009, only the earliest reports were put on general sale; the rest were produced in small numbers for official circulation. The full set sits today in the National Archives at Kew, in file MAF 33/913. A scientist of the 1940s or 1960s who wanted to know what the British government had found would have had trouble finding out.

The reports were not classified. There is no record of an order to suppress them. But the practical effect of a government putting eighteen years of results in a filing cabinet is much the same as hiding them, and it helps explain why later researchers so often started from nothing. We will come back to this in Part Four, because it matters.

For now, note what the documents contain. They do not record a triumphant success that was then buried. They record a real but erratic effect that the best people available could not tame, set aside by a government in the middle of the Depression.

CHAPTER ELEVEN

America Says No

While Britain was testing electroculture and finding something, the United States was testing it and finding nothing.

Arlington Farm

The United States Department of Agriculture had begun electroculture experiments in 1907, at the Arlington Experiment Farm in Virginia, on the ground where the Pentagon now stands. The work was led by Lyman J. Briggs, a physicist who would later direct the National Bureau of Standards and chair the committee that started America's atomic bomb project. He was, in other words, a physicist of the highest competence, with a physicist's care about measurement.

Over a number of seasons Briggs and his colleagues A. B. Campbell, R. H. Heald and L. H. Flint ran overhead-network trials on wheat and other crops, measuring the voltage on the wires and the current reaching the plots, and comparing the treated plots with controls far enough away, or screened by earthed wires, to be free of drift. They also grew plants under insulated and earthed cages, repeating Grandeau.

Bulletin 1379

The results appeared in January 1926 as USDA Department Bulletin No. 1379, titled simply *Electroculture*. The first part reviews the entire history from Maimbray onward and is still one of the best summaries of the early work. The second part reports the Arlington experiments.

The conclusion was negative. The electrified plots did not differ from the controls by more than the controls differed from one another. Of the whole

literature the bulletin said that a review of electrocultural experimentation “does not lend assurance of great progress.”

Two governments, two answers

How could Blackman find a twenty-two percent average gain and Briggs find none? Several explanations have been offered, and none can be proved.

- *Climate.* Lemström and Blackman both found that heat and dry soil turned the effect negative. A Virginia summer is not a Scottish one. The American trials may have been run under just the conditions in which the treatment fails.
- *Dose.* The currents and daily hours differed. Blackman believed the useful range was narrow.
- *Chance and bias.* The British effect may have been a run of luck in unreplicated plots, helped by the natural hopes of the experimenters. On this reading Briggs simply got the right answer first.

What can be said is that the American bulletin, unlike the British reports, was printed and distributed in the ordinary way to every agricultural library in the country. For American agronomists it closed the subject. It is in the public domain and can be read free online today, which is worth remembering when one is told that governments concealed the research. The most widely circulated official document on electroculture ever published is one that says it does not work.

CHAPTER TWELVE

Christofleau, Lakhovsky, and the Antenna Dream

While government scientists strung powered wires over oat fields, a different electroculture was being born in France, one that needed no power at all. It is this French tradition, not the British one, that today's copper coils descend from.

Justin Christofleau

Justin Christofleau was an inventor living at La Queue-les-Yvelines, west of Paris. In the years around the First World War he patented and sold what he called an electro-magnetic terro-celestial apparatus. It was a tall pole carrying a metal arm aligned north and south, with points to gather atmospheric electricity, elements meant to produce current from the sun's heat and from differences between metals, and galvanized wires leading down and running under the soil along the rows.

Christofleau's claims were enormous. In his book *Electroculture*, issued in English in 1927, he described crops doubled and tripled, cereals over seven feet tall, vines cured of phylloxera, exhausted land restored, and all without manure or chemical fertilizer. He stated that he held honors from learned societies and that well over a hundred thousand of his devices were in use.

Three things should be said plainly. First, these figures come from Christofleau, a man selling the apparatus. I have found no independent trial, by an agricultural station or anyone without a stake, that confirms them. Second, the often-repeated story that his invention was suppressed, or that a foreign power offered him millions for the rights, likewise rests on promotional literature; I have found no document that supports it. Third, his

device was a passive collector of the same family as Forster's wires of 1844, which had failed in open trial eighty years before.

Christofleau's lasting contribution was not a result. It was a picture: the aerial on a pole, pointing north, drawing down the energy of the sky. That picture is on a thousand websites now.

Georges Lakhovsky

Georges Lakhovsky was a Russian-born engineer living in Paris, and his ideas were stranger and more ambitious. He proposed that every living cell is a tiny oscillating electrical circuit, that health is the proper oscillation of the cells, and that disease is a disturbance of it that the right external field could correct.

In the mid-1920s he carried out his most famous experiment. Geraniums were inoculated with the bacterium that causes crown gall, a plant tumor. Around some of the plants he placed a single open ring of heavy copper wire, about a foot across, held on an insulating stake and connected to nothing. He reported that the ringed plants shed their tumors and thrived while the others died. His photographs of the geraniums were printed in his books, among them the one known in English as *The Secret of Life*.

The Lakhovsky coil is the direct original of the modern copper ring and spiral. And its evidence is what you have just read: a handful of plants, in one man's hands, in the 1920s. Crown gall tumors do sometimes dry up and fall away on their own, and plants vary greatly in how they tolerate them. I know of no controlled replication that has confirmed the result in the century since.

Two roads

By 1930 there were therefore two electrocultures, and they had little to do with each other.

One was powered, measured, tested by governments, and had produced a real if unreliable effect in careful hands. It was about to be abandoned as uneconomic.

The other was passive, unmeasured, promoted by its inventors, and had never passed an independent trial. It was about to go underground, into the literature of dowsing, cosmic rays and alternative agriculture, where it would

survive for ninety years and from which it would return, in our own decade, on a telephone screen.

Much of the present confusion comes from this: the modern movement uses the devices of the second tradition and cites the evidence of the first.

PART FOUR

Was It Hidden?

The record examined

CHAPTER THIRTEEN

The Case for Suppression

“He that pleadeth his cause first seemeth just; but his neighbor cometh and searcheth him out” (Proverbs 18:17, ASV). In fairness the suppression story should be heard first, in its strongest form, before it is searched out.

Here is how its best advocates would put it.

The argument

In the first decades of the twentieth century a method existed that raised crop yields by twenty to fifty percent using nothing but a little electricity. A Finnish professor had proved it. A British knight and a British government committee had confirmed it; the government’s own botanist measured a twenty-two percent average gain. The method required no fertilizer and little or no pesticide.

At exactly that moment a new industry was being built. In 1909 Fritz Haber showed how to make ammonia from the nitrogen of the air, and in 1913 the German firm BASF opened the first plant. The same process made explosives for two world wars. After each war enormous ammonia capacity stood idle, and it was turned to fertilizer. Chemical companies, among the largest corporations on earth, now depended on farmers buying nitrogen by the ton every year, forever. The same firms and their successors sold the pesticides.

A method that let the farmer grow more with less was a direct threat to that business. And look at what happened. The British committee was shut down. Its reports were never published and lay unseen in an archive for seventy years. The universities dropped the subject. A generation of agronomists was trained without hearing the word. Christofleau’s apparatus disappeared from the market. Is it likelier that a proven technique was simply

forgotten, or that it was made to be forgotten?

What is true in it

A good deal of this is fact, and should be granted.

- The Haber–Bosch process and the electroculture trials do belong to the same years.
- The fertilizer industry did become enormous, and it did shape agricultural research, teaching and government policy to favor its products. That is ordinary, well-documented history.
- Industries have at times buried inconvenient science. The tobacco and lead industries are proven cases.
- The Electro-Culture Committee's reports were in fact kept out of general circulation, and no one has given a fully satisfying account of why.
- The subject did all but vanish from agricultural science after 1936.

So the suppression story is not a foolish one. It fits a pattern that has really occurred, and it is built around a real oddity in the record. The question is whether, in this case, it is what happened. To answer that we have to do what the proverb says and search it out.

CHAPTER FOURTEEN

What the Record Shows

A suppression leaves traces. Someone gives an order, pays money, buys a patent, threatens a researcher, withdraws a grant. When the tobacco companies hid what they knew, the proof eventually came out of their own files. So the first question is simple: what documents show that anyone acted to bury electroculture?

I have looked for them, and I have not found one. There is no known memorandum, no letter, no purchased patent, no testimony from a silenced scientist. The writers who assert suppression do not cite any; they infer it from the fact that the method faded. That is not proof that nothing of the kind ever happened. It is a statement about the evidence as it stands, and it is the honest starting point.

What the record does contain is a set of ordinary reasons, each well documented, that are sufficient to explain the fading without any conspiracy.

It was never hidden from view

Lemström's book was published openly in London in 1904 and sat on library shelves throughout the century. Blackman's results were printed in the *Journal of Agricultural Science* and the *Proceedings of the Royal Society*, two of the most widely held journals in the world. The USDA bulletin was distributed free. Christofleau's and Lakhovsky's books stayed in print or in circulation. All of these can be read at no cost on the internet now. The core of the evidence was public the whole time.

The effect was unreliable

This is the reason given by the people who did the work, in their own reports, year after year. A farmer cannot adopt a practice that gives him twenty percent more one year and five percent less the next. No one involved, including electroculture's friends, claimed to have solved this.

It lost on cost

The overhead system needed poles, insulators, miles of wire, a high-voltage supply and a rural electricity connection at a time when most farms had none. Sulfate of ammonia needed a cart. And fertilizer worked every time, on every farm, in a way the farmer could see within weeks. Farmers did not need to be manipulated into preferring it. Synthetic nitrogen displaced electroculture the way the tractor displaced the horse: by being better at the job.

It is worth adding that the fertilizer industry had little to fear in any case. Nothing in Blackman's results suggested that electrified crops needed less nitrogen. A crop that yields a fifth more removes more nitrogen from the soil, not less.

Nobody could explain it

Science gives its attention to effects it can build on. Electroculture had no agreed mechanism, and so there was no way to predict when it would work, improve it, or teach it. An unexplained and inconsistent effect is exactly the kind of thing researchers drift away from, in every field, without anyone telling them to.

The timing was terrible

The Committee was wound up in 1936, in the depths of the Depression, when every ministry was cutting. Three years later Britain was at war again. After the war the tide of cheap nitrogen, new pesticides and new crop varieties that we call the Green Revolution carried agricultural science in another direction entirely.

And the Committee's reports?

This remains the one real puzzle. The simplest reading is bureaucratic, not sinister: these were interim reports of an advisory committee to a ministry, and such documents were routinely printed in small numbers for internal use. A committee whose conclusion is “disappointing” does not usually get a publication budget. But it is fair to say that the decision was a poor one, that it did real harm to later research, and that no one has fully documented the reason.

The verdict on “hidden”

Electroculture was not hidden. It was tested in public, by governments, at length; it gave results too erratic to use; and it was overtaken by something cheaper and surer. Then it was neglected, and one important set of records was left to gather dust. Neglect is not as good a story as conspiracy, but it is what the documents show.

There is one more thing to say, and it cuts the other way. If electroculture in its powered form produces even a reliable ten percent, the people with the most to gain today are not backyard gardeners. They are the largest agricultural companies on earth, who would patent it, sell it, and say so loudly. As we will see, some companies and governments are now doing exactly that. A truly suppressed technology does not show up in the journal *Nature Food* and in state-funded Chinese greenhouses.

CHAPTER FIFTEEN

The Quiet Years

After 1936 electroculture did not die. It became a minor specialty, pursued by scattered individuals who mostly did not know of each other, and several of them found things worth knowing.

Too much of a good thing

In the early 1960s Lawrence Murr, then at Pennsylvania State University, grew grasses and other plants between charged plates in the laboratory and published the results in *Nature* and elsewhere. He showed clearly what the old field workers had suspected: at high field strengths, plants are injured. The tips of the leaves, where the field concentrates, pass a discharge current, lose water, brown and die. Murr's work established that there is a dose, and that above it electricity harms. Below the damage threshold he reported some stimulation, modest and variable.

Ions in the air

At the University of California, Albert Krueger spent years on the biological effects of air ions, the charged molecules that an electrical discharge produces. He reported that seedlings of oats and barley grew faster in air enriched with ions and more slowly in air stripped of them. This offered a possible mechanism for the overhead-wire effect: perhaps the plant responds not to the field itself but to the stream of ions it sets moving. In 1981 Herbert Pohl and a colleague, publishing under the old name "electroculture," reported increased flowering in plants supplied with negative air ions.

A theory at last

The most interesting idea of these years came from Andrew Goldsworthy, a plant scientist at Imperial College, Blackman's old institution. Goldsworthy asked why a plant should have evolved any response to electric fields at all. His answer was the thunderstorm.

For some time before rain, the electric field at the ground changes sharply. A plant that could sense that change, and respond by gearing up its metabolism to take advantage of the water about to arrive, would have an edge over one that could not. On this view the electroculture effect is real but is not a feeding of the plant. It is a false alarm: the wires imitate the electrical signature of an approaching storm, and the plant responds as if rain were coming.

The theory explains several stubborn facts at once. It explains why tiny currents work as well as large ones, since it is a signal and not an energy supply. It explains why the treatment helps well-watered crops and harms dry ones, since a plant tricked into rapid growth without water to sustain it suffers. And it explains the erratic field results, since the real weather is sending its own signals all the while.

It has not been proved. But it remains the most coherent account anyone has offered of why Lemström and Blackman might have seen what they reported.

Meanwhile, in China

One more development of the quiet years would turn out to be the most important. In 1990 the Chinese government began funding experiments with high-voltage electric fields in vegetable greenhouses. The work continued, with little notice abroad, for nearly three decades. We will come to its results in the next part, where the question at last is put directly.

PART FIVE

Does It Work?

The evidence weighed

CHAPTER SIXTEEN

What a Plant Is, Electrically

Before asking whether electricity can help a plant, it helps to know that a plant is already an electrical thing. This is not a fringe idea. It is in every textbook of plant physiology.

The living battery

Every living plant cell keeps a voltage across its outer membrane, the inside negative to the outside, typically by more than a tenth of a volt. That is a larger voltage than most animal cells maintain. The cell spends a considerable part of its energy pumping charged atoms, chiefly hydrogen ions, across the membrane to keep that voltage up, and then uses it as the driving force to pull in nutrients. When a root takes up potassium, nitrate or phosphate from the soil, it is doing electrical work.

Signals

Plants also send electrical signals. In 1873 the English physiologist John Burdon-Sanderson recorded an action potential, the same kind of electrical pulse that runs along an animal nerve, in the leaf of a Venus flytrap as it snapped shut. In the early 1900s the Indian physicist Jagadish Chandra Bose showed similar signals in the sensitive plant, *Mimosa*, and argued that all plants have something like them. He was partly mocked for it in his lifetime, and he was largely right.

Modern instruments have confirmed it in detail. When a caterpillar bites a leaf, a wave of electrical and calcium activity spreads from the wound through the plant's veins within seconds to minutes and switches on defensive chemistry in leaves the insect has not yet touched. A team led by

Masatsugu Toyota filmed this in 2018, the wave glowing as it traveled, and published it in *Science*.

Fields

Plants respond to external electric fields as well. Growing roots bend in a field, a response called electrotopism. Pollen tubes steer by electrical gradients. And the flower itself carries a charge: in 2013 researchers at the University of Bristol showed that bumblebees can sense the weak electric field of a flower and use it to tell which blossoms have recently been visited.

What this does and does not prove

All of this establishes one thing firmly: it is entirely plausible that an applied electric field or current could change how a plant grows. Anyone who says electroculture is impossible in principle is wrong.

But plausibility is not proof, and it carries a warning. A system that runs on finely regulated voltages of a tenth of a volt is not obviously improved by an outside jolt. An engine runs on sparks, and that does not mean more sparks from outside make it run better. Whether a given electrical treatment helps, harms or does nothing is a question only experiment can answer, one treatment at a time.

CHAPTER SEVENTEEN

How Much Electricity Is in the Sky?

The passive method rests on a single claim: that the atmosphere holds free electrical energy and that a wire can deliver a useful amount of it to a plant. This can be checked with numbers, and the numbers have been known for a century.

The fair-weather field

The earth and its atmosphere form a great electrical circuit. Thunderstorms around the world, a couple of thousand of them at any moment, pump charge upward, leaving the upper atmosphere a few hundred thousand volts positive with respect to the ground. In fair weather that voltage shows up near the surface as a vertical electric field of roughly 100 to 150 volts for every meter of height.

That sounds like a great deal. The top of a six-foot pole stands in air nearly three hundred volts above the ground. Why can you not light a lamp with it? Why does it not shock you?

Because voltage is not energy. Air is an excellent insulator, and almost no current flows through it. The fair-weather current that drifts down from the sky to the ground is about two picoamperes on each square meter, two millionths of a millionth of an ampere. The moment you touch that three hundred volts with anything conductive, it collapses, because there is nothing behind it. Your own body, standing in the garden, is at ground potential from head to foot, and so is every plant.

The arithmetic

Multiply it out. The electrical power passing through the air above one square meter of garden in fair weather comes to less than a billionth of a watt.

Now compare. Full sunlight delivers about a thousand watts to that same square meter. The sun is supplying the plant with roughly a trillion times more energy than the fair-weather electricity of the air. Even if a copper coil could capture every bit of the atmosphere's electrical power over an entire garden bed, which it cannot, it would be delivering energy on the scale of a single flea's jump per day.

So the common statement that an antenna "harvests atmospheric energy to feed the plants" is false as a matter of quantity. There is not enough there to harvest.

What a rod actually does

A grounded metal rod in the open does have real electrical effects, and it is worth knowing what they are.

In fair weather it does almost nothing. It sits at ground potential, and the air around its tip is not ionized. If anything it slightly shields the ground immediately around it, the opposite of what is claimed.

Under a thundercloud, things change. The field can rise to thousands of volts per meter, and then the tip of any pointed, grounded object begins to leak a discharge into the air. Trees do this from their leaves and twigs. The currents are real and measurable, on the order of a millionth of an ampere for a tree. That is a million times the fair-weather figure, and still a very small current, flowing only while the storm is overhead.

Could a brief, tiny current like that matter to a plant? If Goldsworthy's storm-signal idea is right, plants may indeed respond to the electrical signs of a storm. But in that case the plant's own leaf tips already do the job that the antenna is said to do, and the storm is providing the signal with or without the copper.

And lightning?

Lightning does fertilize the earth, as Bertholon's farmers believed. The heat of the stroke joins nitrogen and oxygen, and rain carries the product down as nitrate. Worldwide this fixes several million tons of nitrogen a year, a small but real contribution, roughly a twentieth or less of what fertilizer factories produce. It is spread thinly over the whole planet by rain. No garden device increases your share, and a device that did attract lightning would be a hazard, not a help.

The physics, then, gives a clear answer about one kind of electroculture. Powered systems supply real fields and currents and may do something. Passive collectors have almost nothing to collect.

CHAPTER EIGHTEEN

China's Electric Greenhouses

The largest electroculture program in history is not in the past. It is running now.

The program

In 1990 the Chinese government began funding trials of high-voltage electric fields in vegetable production. The work was led for many years by Liu Binjiang, an agricultural scientist in the northeast of the country. In September 2018 the *South China Morning Post* reported that the Chinese Academy of Agricultural Sciences and other state institutes had released findings covering nearly three decades of study, in regions from the Gobi fringe of Xinjiang to the Pacific coast.

By that report, greenhouses with a combined area of more than 3,600 hectares, almost nine thousand acres, were taking part. Bare copper wires were strung about three meters above the crop and charged with pulses of up to fifty thousand volts. The current was said to be a few millionths of an ampere, and the electricity consumption about fifteen kilowatt-hours per hectare per day, a trivial amount.

The reported results

The figures reported were these:

- vegetable yields higher by 20 to 30 percent;
- pesticide use lower by 70 to 100 percent;
- fertilizer use lower by more than 20 percent.

The area under treatment was said to be growing by a thousand hectares or more each year, increasingly with private money. Liu was quoted as saying there was no plan to electrify all of China's four million hectares of greenhouses, because the equipment cost too much for most farmers, and that his team was working on a small all-in-one growing chamber for household use.

How to read this

This is, on its face, the strongest modern evidence that powered electroculture works, and it deserves both respect and care.

In its favor: the scale is large, the duration is long, the method is the classical Lemström and Blackman system, the yield figure matches what Blackman found a century earlier, and private growers have been paying for installations with their own money, which is a kind of evidence that reports alone are not.

The pesticide result is also physically sensible. A high-voltage discharge in an enclosed space charges dust, spores and fine water droplets and drives them out of the air, the same principle used in industrial electrostatic air cleaners, and produces small amounts of ozone and ions that suppress microbes. Cleaner air in a humid greenhouse means less fungal disease. Some of the yield gain may come simply from healthier plants.

The cautions are these. What reached the outside world was a newspaper account of an announcement by the program's own scientists. I have not found the underlying data, with controls and statistics, published in full in the international peer-reviewed literature. Some of the installations combined the electric field with artificial lighting, which would raise yields by itself. And the results are from greenhouses, enclosed and controlled, which is a very different thing from an open field or a backyard bed.

The fair conclusion: there is substantial, though not rigorously published, evidence that high-voltage overhead fields can raise vegetable yields and reduce disease in greenhouses. This is good evidence for powered electroculture in protected cultivation. It is no evidence at all for an unpowered coil.

CHAPTER NINETEEN

The New Laboratory Evidence

In the last few years electroculture has returned to the front rank of scientific journals, with tools the old workers never had.

Peas, wind and rain

In January 2022 the journal *Nature Food* published a study by a Chinese team led from Zhejiang University, with the nanotechnology pioneer Zhong Lin Wang among the authors. They built a small generator that turns the motion of wind and falling rain into high-voltage electricity by friction, a triboelectric nanogenerator, and used it to maintain an electric field over growing peas. They reported that the treated peas germinated about 26 percent faster and yielded about 18 percent more than untreated ones, and that the device cost only a few tens of dollars to make.

This is a real result in a leading journal, and its yield figure again falls close to Blackman's. It is also a single small-scale experiment. Commentators at the time pointed out that other differences between the plots could have contributed, and it awaits independent repetition on a larger scale. Note too that this was a powered system: the wind and rain drove a generator that produced tens of thousands of volts. It was not a passive antenna.

Electronic soil

In late 2023 a group at Linköping University in Sweden, led by Eleni Stavrinidou, published in the *Proceedings of the National Academy of Sciences* a study of what they called eSoil. They grew barley seedlings hydroponically in a growing mat made of cellulose mixed with an electrically conductive polymer, so that a small voltage could be applied directly at the roots. Seedlings whose roots were stimulated for a period grew, over fifteen days, to about 50 percent more dry weight than unstimulated ones. The power used was very low.

The authors were frank that they do not yet know the mechanism, and that seedling growth over two weeks is not the same as yield at harvest. But the experiment was controlled and carefully measured, and it points to a second route for powered electroculture, through the root zone, that may suit indoor and vertical farming.

Seeds and plasma

A third line of work treats the seed before planting. Exposing seeds briefly to an electric field, a pulsed discharge, or a cold plasma has been reported in many studies to speed germination and early growth in various crops, probably by roughening the seed coat, letting water in faster, and killing surface microbes. Results vary by species and dose, and too much treatment damages the seed. This is an active research field with commercial interest.

What the new evidence adds up to

Three things stand out.

First, the modern studies agree with the old ones on the general size of the effect of powered treatment where one is found: gains of perhaps a fifth, not doublings or triplings.

Second, they agree that it is still not understood. More than a century after Lemström, nobody can state the mechanism with confidence, and that remains the main obstacle to making the effect dependable.

Third, every one of these positive results involved electricity that was generated and applied. Not one involved a passive coil.

CHAPTER TWENTY

The Copper Coil on Trial

We come now to the thing most readers picked up this book to learn about: the copper wire wound on a wooden stake.

What is claimed

The modern electroculture antenna is usually a wooden dowel or branch a few feet long, wound from bottom to top with bare copper wire, sometimes with a coil or spiral at the tip, pushed into the soil of a bed or pot. Variants include free-standing spirals, copper rings around the stem after Lakhovsky, pyramids, and coils wound to particular proportions. Instructions often specify winding clockwise in the northern hemisphere and aligning to magnetic north.

It is claimed to raise yields greatly, speed growth, reduce pests and disease, and cut the need for water and fertilizer.

What the evidence is

I have searched for controlled, replicated, peer-reviewed trials showing that a passive copper antenna improves plant growth. I have not found one.

The evidence offered consists of testimonials and before-and-after or side-by-side photographs. Where gardening educators and extension writers have run their own simple side-by-side comparisons, the ones I have seen report no difference. I should be exact about the limits of that statement: informal tests are not rigorous either, and the absence of a published positive trial is not the same as a published negative one. This is a cheap experiment that agricultural science has mostly not bothered to do.

But three bodies of evidence do bear on it. The history: the unpowered wire was tried by many people at once in 1845 and failed. The physics: as an earlier chapter showed, there is almost no energy for such a device to deliver. And the pattern of the claims themselves, which grow larger the less measurement is involved.

Why honest people see results

Most people who report success with a coil are not lying. They saw what they saw. The question is what caused it. There are several well-understood answers.

- *No real comparison.* “My tomatoes did better than last year” compares different weather, different seed and a more experienced gardener. One plant with a coil beside one without is a sample of one; any two plants differ.
- *Placement.* People put the new device on the plant or bed they care most about, which tends to be the one in the best spot.
- *Attention.* A gardener trying something new visits that bed more, waters it more faithfully, weeds it, notices problems sooner. Ingenhousz identified this in the 1780s.
- *The winners post.* A person whose coiled plant thrived makes a video. A person whose coiled plant did nothing does not. Viewers see only one side.
- *Copper itself.* Bare copper in damp soil slowly releases copper ions. Copper is a necessary plant micronutrient, a long-established fungicide, and reputed to deter slugs. In a soil short of copper, or a bed troubled by fungus, a length of copper wire could do some real good by chemistry alone, and a piece of copper scrap would do the same. In excess, copper is toxic to plants and soil life.

None of these requires the antenna to collect anything from the sky.

The galvanic case

The buried copper-and-zinc pair is a different matter and should not be dismissed with the coil. Here a real current does flow, and you can measure it with an inexpensive meter. Whether that current does a plant any good has, as far as I can find, not been properly tested in modern times. The metals also dissolve, zinc especially, and zinc too is a micronutrient, so any trial must include buried but unconnected plates as its control. The honest status of galvanic electroculture is: real current, unknown effect.

CHAPTER TWENTY-ONE

The Verdict

It is time to answer the question directly.

Does electroculture work? It depends on which electroculture, and the evidence can be sorted into four plain verdicts.

Powered overhead fields: probably yes, modestly, under the right conditions

A high-voltage field maintained over a crop has been reported to increase yield by roughly a fifth by independent workers across more than a century: Lemström in the 1890s, Blackman in the 1920s, the Chinese program since the 1990s, the *Nature Food* study in 2022. The effect appears most dependable in greenhouses and on well-watered crops, and it has repeatedly failed or reversed in hot, dry or uncontrolled conditions. One careful government study, in the United States, found nothing. The mechanism is not established. I judge it more likely than not that the effect is real, and far from certain. It is not a practical or safe method for a home garden.

Powered root-zone stimulation: promising, early

The eSoil work shows a clear effect on seedlings under laboratory control. It has not yet been shown to raise harvest yield, and it has not been widely repeated. It is a research result, not a gardening method.

Galvanic pairs: unknown

A real but small current flows. No adequate modern trial exists. It is cheap and safe to test for yourself, and Part Six shows how.

Passive antennas and coils: no good evidence, and good reason to doubt

No controlled trial supports them. The one mass trial in history went against them. The energy they are said to collect is, by measurement, about a trillionth of what sunlight supplies. Where benefits are seen, ordinary explanations are available. I cannot tell you with certainty that a copper coil does nothing; no one has done the definitive experiment. I can tell you that there is at present no sound reason to believe it does what is claimed.

The other three questions

When did it start? In 1746, with Maimbray's myrtles in Edinburgh, and as a proposal for agriculture in 1783, with Bertholon's book.

Who started it, and why? Clergymen and natural philosophers of the Enlightenment, who had just learned that the sky is electric and reasonably wondered whether that electricity was part of how God makes the fields grow. It was carried forward by a Finnish physicist curious about the Arctic, by a British government afraid of hunger, and by a Chinese government with more than a billion people to feed.

Has it been hidden? No. It has been repeatedly tested and repeatedly set aside because its results were inconsistent and its costs exceeded those of fertilizer. One government's reports were left unpublished, which was a real loss. There is no documentary evidence of deliberate suppression, and the most promising form of it is being actively developed and published today.

That is the state of the question. If it is less than you hoped for, consider the other side of it. Here is a real open problem in agriculture, three centuries old, on which a careful amateur with a few garden beds can still gather evidence worth having. The next part shows how.

PART SIX

Your Garden

Proving all things

CHAPTER TWENTY-TWO

How to Run an Honest Trial

You do not have to take my word, or anyone's, about what works in your own soil. You can find out. A fair garden trial costs almost nothing extra, and it will teach you more than any book. The whole art lies in removing the ways we fool ourselves.

Rule one: compare like with like, at the same time

Never compare this year with last year, or your garden with your neighbor's. Grow treated and untreated plants in the same season, from the same seed packet, in the same soil, with the same water and the same sun.

Rule two: replicate

One treated plant and one control tells you nothing, because any two plants differ. Use at least six pairs, more if you can. Identical containers filled from one well-mixed batch of soil are ideal, because they remove differences in the ground. If you use beds, divide them into small matched plots.

Rule three: let chance decide

Do not choose which plants get the treatment. You will, without meaning to, pick the better ones or the better spots. For each pair, flip a coin: heads, the left pot is treated; tails, the right. This single step is the difference between an experiment and an anecdote. It was introduced into agriculture in the 1920s at Rothamsted, the very station where electroculture was being tested, and it came too late to be used on most of those trials.

Rule four: use a sham

Give the control plants a dummy that looks and behaves as much like the treatment as possible but lacks the active part. For a copper coil, the control gets an identical dowel wound with string or plastic-coated garden wire. For a galvanic pair, the control gets the same two metal plates buried in the same positions with no wire joining them. Now both groups have a stake to shade them, the same disturbance of the soil, the same metals, and the same attention from you.

Rule five: decide beforehand what you will measure

Before you plant, write down the one thing that will decide the question. Total weight of ripe fruit per plant is a good choice. Do not wait to see which measurement favors the treatment.

Rule six: measure blind if you can

Have someone else label the pots A and B and keep the key until harvest is weighed. If you cannot, at least weigh everything, every time, on a scale, and write it down on the spot. Do not judge by eye.

Rule seven: treat them identically otherwise

Same water, measured. Same feeding. Same pruning. Keep treated and control pots mixed together, not in two separate rows.

Reading the result

At harvest, for each pair, note which plant won. If the treatment does nothing, each pair is a coin toss. With six pairs, the treated plant winning all six would happen by luck only about once in sixty-four tries; that would be worth taking seriously and repeating next year. Five out of six happens by luck about one time in ten and proves little. Four of six is nothing.

Then look at the size of the difference. If treated plants average three percent more, that is noise. Twenty percent across all pairs is interesting.

Whatever you find, write it up honestly, including a result of no difference. A careful null result is worth more to other gardeners than a hundred enthusiastic videos, and it is rarer.

CHAPTER TWENTY-THREE

Building, and Staying Safe

This chapter describes the two forms of electroculture that are safe and cheap to try at home, so that you can test them by the method of the last chapter. I describe them as experiments, not as recommendations. It also says clearly what not to build.

The passive antenna

The usual form:

- A wooden dowel or straight branch, three to six feet long.
- Bare solid copper wire, around 12 or 14 gauge, wound in an open spiral from near the bottom to the top, with a few inches left at the base to go into the soil and often a small coil or loop at the tip.
- Set upright in the bed or pot, pushed a few inches into the soil.

Tradition gives many further rules: wind clockwise in the northern hemisphere, align to north, use particular proportions. I know of no evidence that any of them matters, but if you are testing the claim, follow the instructions as its advocates give them, so that no one can say you did it wrong.

Your sham control is the same dowel wound the same way with something non-conductive.

The galvanic pair

- One plate or strip of copper and one of zinc or galvanized steel, each perhaps the size of your hand.

- Bury them upright at opposite ends of a bed or large trough, a few inches deep.
- Join them above ground with a length of insulated copper wire, with good clean connections.

If you own a multimeter, connect it in place of the wire. In moist soil you will read something on the order of half a volt to nearly a volt between the plates, and a current somewhere from microamperes up to a milliampere or so, more when the soil is wet and less as it dries. That reading is the one thing in backyard electroculture you can actually measure, and it is satisfying to see.

Your control is an identical bed with identical plates and no wire.

What not to build

Do not build a high-voltage system. The methods that have real evidence behind them use tens of thousands of volts on bare overhead wires. Supplies capable of that can kill. Improvised versions made from fence energizers, ignition coils, neon transformers or microwave-oven parts are dangerous to you, to children, to pets and to neighbors, and may be illegal. Leave powered electroculture to people with engineering training and proper equipment.

Do not connect anything in the garden to household mains. Not through a transformer, not through a dimmer, not “just to try.”

Other cautions

- *Lightning.* A tall metal mast in open ground is a lightning attractor. Keep garden antennas short, lower than nearby trees and buildings, and stay out of the garden in a thunderstorm.
- *Buried services.* Before driving any rod or stake deep into the ground, find out where your gas, water, power and cable lines run. In the United States, call 811.
- *Copper build-up.* Copper does not break down. Large amounts of bare copper left in the same soil for years can accumulate to levels that harm earthworms and soil life. A few coils are harmless; do not bury pounds of it.

- *Eyes.* The tip of a wire on a stake is at face height when you bend to weed. Bend the end into a closed loop.

CHAPTER TWENTY-FOUR

The Real Garden Revolution

The title of this book promised a revolution, and I owe you an honest account of whether there is one.

There is not one in the copper coil. If the evidence in these pages is right, the wire on the stake will change very little about your harvest.

There may be one in powered electroculture, and it would be a quiet one: greenhouses and vertical farms growing vegetables under high-voltage wires or in conductive root mats, using less pesticide, perhaps a fifth more productive, engineered by professionals. That would be a real advance in a world that must feed more people from the same land, and it is being worked on now. It took three hundred years to get this far, largely because each generation forgot what the last had learned. If this book helps a few people remember, it has done some good.

But I have come to think the truer revolution is the one that happens in the gardener.

What actually grows a garden

Whatever electricity turns out to do, the things that are known to work are not in doubt, and they have never been hidden either. Soil rich in organic matter. Compost. Mulch to hold water. The right plant in the right place at the right season. Enough water, given deep and not too often. Rotation, so that pests and diseases do not settle in. Attention: the daily walk through the rows that catches trouble early.

It is striking that the last of these is the very thing that confounds the experiments. The gardener who installs an antenna and then watches that bed closely all summer often does get a better crop. The antenna did not do it. She did.

Proving all things

I began with a verse and will end near it. “Prove all things; hold fast that which is good.” It is a command to test, and it assumes that some things will pass the test and some will not, and that it is our duty to care which is which.

People of faith are sometimes tempted to think that doubt is the enemy. In the garden, at least, it is the reverse. To set up a fair trial, to flip the coin, to weigh the harvest and write down the number even when it disappoints us, is a form of honesty before God about the world He actually made, as opposed to the one we might wish for. Creation does not need our exaggerations. It is remarkable enough as it is: a seed the size of a pinhead that knows how to build a tomato vine out of air, water and light, and that carries inside each of its cells a voltage it has maintained since the first day.

“While the earth remaineth, seedtime and harvest, and cold and heat, and summer and winter, and day and night shall not cease” (Genesis 8:22, ASV).

That promise has held longer than any theory. Plant your garden. Feed your soil. Try the soil if you are curious, with six pots and a coin. And whatever you find, tell the truth about it.

Timeline

- 1746 — Dr. Maimbray electrifies two myrtle trees in Edinburgh and reports new growth.
- c. 1747–49 — The Abbé Nollet in Paris reports faster germination in electrified seeds; others report the same.
- 1752 — Franklin shows that lightning is electrical.
- 1779 — Ingenhousz discovers the role of light in plant life.
- 1783 — Bertholon publishes *De l'électricité des végétaux* and describes the electro-vegetometer.
- 1780s — Ingenhousz's controlled trials find no effect; interest fades.
- 1844 — Forster's barley plot in Scotland; Ross's earth battery in New York.
- 1845 — Mass trials in Britain fail to reproduce Forster's result.
- 1870s — Grandeau's cage experiments at Nancy.
- 1885 — Lemström begins overhead-discharge trials in Finland.
- 1904 — Lemström's *Electricity in Agriculture and Horticulture* published in English.
- 1906 — Lodge and Newman begin large-scale trials near Evesham.
- 1909–13 — Haber–Bosch ammonia synthesis demonstrated and industrialized.
- 1914 — Jørgensen and Priestley show that the discharge drifts onto control plots.
- 1917 — Blackman begins field trials.
- 1918 — British Electro-Culture Committee appointed.

- 1923–24 — Blackman publishes laboratory and field results: 14 of 18 field trials positive, mean gain about 22 percent.
- 1920s — Christofleau markets his apparatus; Lakhovsky reports his geranium experiment.
- 1926 — USDA Bulletin 1379 reports no effect.
- 1936 — Electro-Culture Committee disbanded; final report issued early 1937.
- 1960s — Murr documents leaf damage at high field strengths; Krueger studies air ions.
- 1990 — Chinese government begins funding greenhouse trials.
- 2018 — China reports results from 3,600 hectares of electrified greenhouses.
- 2022 — *Nature Food* publishes the wind-and-rain-powered pea study.
- 2023 — Linköping University's eSoil study published in *PNAS*.
- 2020s — Passive copper-coil electroculture spreads through social media.

Glossary

- *Action potential* — A brief, self-propagating electrical pulse across a cell membrane; found in nerves and in some plant tissues.
- *Air ion* — A molecule in the air carrying an electric charge.
- *Ampere (amp)* — The unit of electric current. A milliampere is a thousandth; a microampere, a millionth; a picoampere, a millionth of a millionth.
- *Control* — The untreated group in an experiment, kept alike in every other respect.
- *Corona or point discharge* — A faint leakage of current into the air from a sharp conductor in a strong field.
- *Earth battery* — Two different metals buried in moist soil and joined by a wire, producing a weak current.
- *Electric field* — The condition of space around a charge that exerts force on other charges; measured in volts per meter.
- *Electro-vegetometer* — Bertholon's 1783 mast for bringing atmospheric electricity to plants.
- *Fair-weather field* — The steady vertical electric field of the atmosphere away from storms, roughly 100 to 150 volts per meter at the ground.
- *Galvanic* — Relating to current produced by chemical action between unlike metals.
- *Haber-Bosch process* — The industrial synthesis of ammonia from atmospheric nitrogen; the basis of nitrogen fertilizer.
- *Influence machine* — A static-electricity generator such as the Wimshurst or Holtz machine.

- *Randomization* — Assigning treatments by chance so that hidden differences cannot favor one group.
- *Replication* — Repeating each treatment on several independent plots or plants.
- *Sham* — A dummy treatment given to the control group.
- *Triboelectric nanogenerator* — A device that produces high voltage from friction between materials set moving by wind, rain or other motion.
- *Volt* — The unit of electrical potential, or pressure. Voltage alone does not measure energy.

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A note on sources. Figures for the eighteenth- and nineteenth-century experiments come from the historical reviews in Lemström and in USDA Bulletin 1379 and should be read as those experimenters’ own reports. The figures for the Chinese program are as reported in the press in 2018. Where this book says “I have not found,” it means exactly that: a search was made and nothing turned up, which is not proof that nothing exists.

About the Author

Rev. George H. Stoddard is an ordained minister, author and songwriter, and the founder of In His Hands Ministries International. He has written an extensive catalog of Christian nonfiction, verse-by-verse Bible study guides, biographies and investigative histories under the Booklyn imprint, and writes and produces Southern Gospel music as RockRevster.