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The Original Dr. Evil
Lex Luthor

In "How Luthor Met Superboy" (*Adventure Comics* #271, 1960), Superboy flies to a farm in Smallville to introduce himself to a new kid in town. The kid, who has curly hair, is riding a tractor. A giant meteor of kryptonite falls from the sky and crashes to the ground next to Superboy. The farm kid whisks the meteor away with his tractor, depositing the kryptonite in quicksand. Superboy shakes the farm kid's hand, and the kid proclaims, "Meeting you, Superboy, is about the most thrilling thing that ever happened to me!" The curly-haired farm kid is Lex Luthor.

Luthor takes Superboy into his barn, where there is a shrine to Superboy: photos on the walls, rocks Superboy has punched, metal Superboy has bent. Luthor confesses, "I have hero-worshipped you for years. To me, you are the greatest boy in the world!"

The barn holds more surprises. It also contains an advanced scientific laboratory. As Luthor tells Superboy, his secret goal in life is to become a great scientist as famous as Superboy. To thank Luthor for saving him from the kryptonite meteor, Superboy builds an even more highly sophisticated experimental laboratory out of junk. He also gives Luthor rare chemicals, dug from far beneath the ground at superspeed.

For weeks, Luthor works to uncover the secret of life in his new laboratory. Finally, he creates a secret chemical formula that spawns a live protoplasmic monster.

Luthor's next goal is to create an antidote to kryptonite. He builds a giant claw arm and attaches it to his tractor, then lifts the giant kryptonite meteor from the quicksand. After chipping off some pieces, he drops the meteor back into the quicksand, then grinds the kryponite chunks into dust. He mixes the dust with the protoplasmic life-form that's still writhing—enormous hands flailing, head wobbling like jelly—in a big beaker on his laboratory table.

Unfortunately, as often happens in comics, Luthor stumbles and drops his beaker of protoplasmic monster plus kryptonite dust. The lab blazes with fire. Luthor chokes from the dust, fumes, and radiation.

Superboy arrives almost instantly and uses his superbreath to quell the flames. He rescues his friend, but this is a different Lex Luthor. He's been transformed by the radiation. He's bald, and he's insane. But he's still a scientific genius.

Luthor decides to destroy Superboy. He smashes everything in his shrine. He tricks Superboy into exposing himself to kryptonite in outer space, where Luthor maniacally chortles over the fact that Superboy's dog is choking half to death from the exposure.[1]

In later comics, Superboy often puts Luthor in prison. And Luthor always breaks out, using some weird scientific gizmo or technique. In one particular comic, Luthor is in prison and creates a salve that enables him to stretch his arm clear across Smalltown, where he creates havoc. There is an incredible image of Luthor with his elongated arm stretching across town from the jail cell. Luthor is indeed the villain of all comic book supervillains; he is the ultimate mad scientist.

Let's take a look at some of the scientific methods used by Lex Luthor and determine if they're at all plausible. In addition, let's ponder some techniques that Luthor never used and some he should have used, given his vast scientific expertise.

In the "farm lab" issue (#271) described above, Luthor creates a weather tower that transforms the sun's rays into solar energy in the depths of winter. Smallville installs the weather tower, and the town is blessed with summer flowers, crops, trees with leaves and buds, and gentle warm breezes. But then something goes wrong and the tower starts frying the town. Superboy saves the day, however, with his frosty breath.

Is it possible for solar energy to give Smallville summer weather in the depths of winter? Let's consider some facts. Of the solar energy reaching the Earth, approximately 30 percent is reflected and not used to heat the planet. The atmosphere absorbs an additional 20 percent of solar energy. The ground and oceans absorb the remaining half.[2] When it absorbs energy, the atmosphere grows warmer. The same thing happens with the ground and the oceans.

So how might Lex Luthor's weather control tower work? Our guess is that he uses sun charts and solar collectors. The position of the sun in the sky changes every day, and it differs depending on latitude (that is, where you are on the planet). However, for any time of any day, Luthor can predict the position of the sun in the sky. We figure that he then uses his mathematical predictions to design solar collectors that absorb the most sun and create the most heat.

Running on a computer, Luthor's mathematical predictions can take into account how Smallville's houses, schools, shops, trees, chunks of kryptonite, and other obstacles block the solar energy reaching his weather control tower. The math must also include calculations that compensate for fog, rain, dry spells, and pollution, as well as any blizzard, hurricane, or tornado that might hit the town.

Solar collectors are used today, of course. Even ten years ago, renewable energy supplied 18 percent of the world's energy.[3] Renewable energy either regenerates or cannot be depleted, and it includes solar energy.

Photovoltaic solar energy is used in calculators and wristwatches. It converts the sun's energy directly into electricity. Silicon combined with other materials in the photovoltaic cells enables electrons from the sun to move through the silicon, hence producing current. It does not appear that Lex Luthor uses photovoltaic power in his weather tower. Otherwise, he'd electrocute Smallville!

The weather tower is shown with a huge parabolic dish, which we assume collects and concentrates solar energy on a series of receivers. Once collected, this energy must be harnessed, but how?

Solar thermal systems transfer the sun's heat into fluids such as water. It most definitely does not appear that Luthor's weather tower converts the heat into fluid form. There is no evidence that Smallville is flooded by water or any other fluid.

While it's possible to collect and use solar energy, we do not believe it makes sense in the way that Luthor does it. One parabolic dish at the edge of town just doesn't suffice to radiate heat all over Smallville and its outlying farms, causing flowers to blossom in winter, crops to grow, trees to bud, and people to wear bikinis. That's just way too much heat being radiated from one dish. And we cannot conceive how that solar energy is being converted and distributed to such a wide area simply through the sky, with no liquid, no electrical equipment, and no conductors of any kind. Here we have a grounding in good science but an unfeasible application. At least according to current technology.

Most of Luthor's comic science leans heavily toward super-futuristic wonders. One example is teleportation. In "The Einstein Connection" (*Superman* #416, 1986), Lex Luthor perfects a teleportation machine and is able to make himself temporarily invisible whenever Superman gets too close. Superman follows Luthor to Princeton University. "You muscle-bound simpleton!" exclaims Luthor, as he zaps Superman with his "concussion blast" watch. Luthor steals a perpetual motion machine and creates illusions, such as multiple Luthors who don't really exist, rooms and walls that aren't really there, and waterfalls in the middle of nowhere.

Is teleportation possible? And is it possible to create illusions, such as multiple Luthors who don't really exist, rooms and walls that aren't really there, and so forth? A staple of science fiction, teleportation refers to the process of disintegrating a person or object in one place, then reconstituting the person or object in another place. It's generally done within seconds and usually never explained except in terms that are equally mystifying, such as *Star Trek*'s "pattern buffers."

Scientists have made some progress in the study of teleportation. Ten years ago, for example, a group of six scientists provided evidence that teleportation could happen, but only if the original person or object was destroyed in the process.[4] In 1998, using coaxial cable, scientists at the California Institute of Technology teleported a beam of photons from one end of a table to another. And in 2002, Australian physicist Ping Koy Lam teleported a laser beam approximately one meter from its origin by embedding a radio signal into the laser beam, destroying the original beam, then recreating it elsewhere. Although the original beam had to be destroyed during the teleportation process, the radio signal did survive.

The destruction is a result of the Heisenberg uncertainty principle, which states that the more definite you are about a particle's location, the less definite you are about its velocity, and vice versa—that is, you can't duplicate the exact spin and polarization of a particle at any given fragment of time. Instead, scientists use a process called quantum entanglement, whereby two photons are created simultaneously, and the changes made to one photon also occur in the other regardless of how far apart they are—for example, at opposite ends of the table.

Obviously, we are far away from teleporting humans. When you consider that a person—say, Lex Luthor—has approximately 10^{27} atoms in his body, it would be a great effort to teleport him a meter away, much less to another room, city, or planet. And once you teleport him, what happens to the original Lex Luthor? Is he destroyed due to quantum entanglement and the Heisenberg uncertainty principle? Are his exact thoughts and physical conditions (upset stomach, rapid heartbeat, infusion of narcotics into his blood, use of lifesaving heart medicines, and so forth) also transmitted? Probably not. The teleported Luthor would not be a perfect copy of the original Luthor.

Is it possible to create illusions, such as multiple Luthors who don't really exist, and rooms and walls that aren't really there? Two possibilities are that Luthor is using virtual reality or holographs.

Virtual reality is a computer-generated world in which we move and interact with objects, other real people, and virtual reality people. It's a place that doesn't exist but that offers the powerful illusion of tangibility.

Virtual reality today comes in two flavors. One surrounds you with three-dimensional objects and scenes so that you feel you are walking through a real place. This effect requires equipment: virtual reality goggles, for instance, or specially equipped rooms. Unless Superman is wearing goggles or other virtual reality equipment, Luthor is not using this form of virtual reality to produce his illusions.

The second type appears before you on a two-dimensional screen such as your computer monitor. The computer graphics and programming are so well done that a full three-dimensional world feels real on your two-dimensional screen. Many computer games are forms of virtual reality. Clearly, Luthor isn't using this type of virtual reality. Superman is not looking at Luthor on a computer screen.

So what is Luthor doing? Our best guess is that he's projecting holographs of walls, rooms, and himself. In holography, laser light is used to record the light-wave patterns reflected from an object or person. The light-wave patterns are placed into an emulsion of light-sensitive film. After the film is developed, it is again exposed to laser light. All points of light originally reflected from the object or person are captured, and the final image—whether you're standing in front of the holograph, behind it, or to its side—looks just like the object or person.

If Superman tried to touch one of the Luthor holographs, his hand would find only light. In a similar fashion, if Superman tried to punch his way through a wall, he'd be banging through empty space.

Luthor's holograph machine can work in various ways. For example, if Luthor is using a reflection holograph technique, then he's lighting his illusions from the front. If he is using a transmission holograph technique, then he's lighting his illusions from the back.

Most likely, he's employing pulsed holography or integral holography. Pulsed holography uses bursts of laser light to record a subject's movements. If Luthor's illusions move a good deal, then it's more likely that he's using integral holography, which converts individual frames of two-dimensional film footage, computer graphs, or digital video into holographs.

In another deadly scene, “The Luthor Nobody Knows” (*Superman* #292, 1975), Luthor escapes from prison and takes over a helicopter on an army base where they’re detonating nuclear bombs. He steals a nuclear bomb and flies very close to a town. As Superman rescues Luthor from the helicopter, it explodes, and the nuclear bomb goes sky high. Somehow, the people in the nearby town are not hurt.

Now if a nuclear bomb explodes about a mile outside town, would the people be hurt? And what other methods might Luthor use to kill people from his helicopter?

Although it’s true that bombs existed in 1975, their use in the Lex Luthor comics was more than fantastic. It seems that the Luthor bombs were not based on scientific fact.

Although battlefield nukes have existed since the mid-1950s, this is not the type of nuclear weapon that Lex Luthor uses near the town. An example of a battlefield nuke is an M573 or M422 8-inch nuclear projectile. Providing on-ground attack capability, these nukes tend to hit their targets with great accuracy. During the 1990s, however, the army and marines replaced most on-ground nuclear artillery weapons with more conventional weapons.[5]

But Luthor’s bomb was the type dropped on Japan during World War II—a free-fall bomb. He dropped it from an airplane. He did not load it into a rocket launcher outside of town or from a submarine deep beneath the surface of the Pacific.

Clearly, if such a nuclear bomb were to explode about a mile outside town, most of the townspeople would die. World War II’s Fat Man Model 1561, for example, destroyed 1.5 square miles of Nagasaki and killed 35,000 people. The Little Boy bomb destroyed 4 square miles of Hiroshima and killed 70,000 people. When accidentally dropped in 1957, a Mark-17 bomb created a 25-foot-wide, 12-foot-deep crater and threw debris to locations over a mile away. During this accident, only the bomb’s conventional explosives detonated—imagine the destruction had the nuclear arsenal detonated.

In general terms, a nuclear bomb releases the forces that hold the nucleus of an unstable atom together. This can be accomplished in two ways. With nuclear fission, the nucleus is split into two fragments; isotopes of uranium or plutonium are typically used. With nuclear fusion, two atoms are brought together; hydrogen or hydrogen isotopes are typically used.

There are many ways of devising and detonating bombs. Some of the most common nuclear bomb designs are

- Fission bombs (the earliest type of bomb)
- Gun-triggered fission bombs
- Implosion-triggered fission bombs
- Fusion bombs

To understand how a fission bomb works, you need some basic knowledge about nuclear radiation. Each atom consists of subatomic particles: protons and neutrons form the atom's nucleus and electrons orbit the nucleus. Protons have positive charges, electrons negative charges, and neutrons no charge at all. Usually, the numbers of protons and electrons in an atom are the same. The role of the neutrons is basically to keep the protons together in the nucleus. Because the protons all have the same charge—positive—they repel one another.

Some elements have more than one stable form. By stable, we mean that you could leave the element alone for five hundred years, then return to find that it hasn't changed at all. For example, the copper, gold, and silver in objects found during the excavation of an ancient Roman city are exactly the same as they were two thousand years ago.

In fact, speaking of copper, 70 percent of all natural copper is called copper-63, and the other 30 percent is called copper-65. Each type of copper has 29 protons, but a copper-63 atom has 34 neutrons and a copper-65 has 36 neutrons: similar, but slightly different. Both copper-63 and copper-65 are stable forms of the element. Both are called isotopes of copper.

Some isotopes happen to be radioactive. In the most simple terms, radioactivity means that an isotope is unstable. For example, one of the hydrogen isotopes, which is called tritium, is radioactive. It has one proton and two neutrons. Over time, it transforms by means of radioactive decay into the more stable isotope called helium-3, which has two protons and one neutron.

Pretty cool, huh? Now there are three ways that a radioactive isotope will decay: alpha decay, beta decay, and what we're interested in talking about here, spontaneous fission. (This is how, by the way, alpha, beta, gamma, and neutron rays are formed.) For example, a fermium-256 atom, which is really heavy, may split into one xenon-140 atom and one palladium-112 atom, and in the process, shed four neutrons. These four neutrons may crash into other atoms and cause various nuclear reactions.

Induced fission means that an element can be forced to split. Uranium-235, often used in fission bombs, is a good example of such an element. If a uranium-235 nucleus is hit by a free-floating neutron, then the nucleus instantly becomes unstable and splits. This kind of thing happens to cause a nuclear explosion.

In a gun-triggered fission bomb, explosives propel a uranium-235 bullet down a barrel. The bullet hits a generator, which launches the fission reaction. Basically, Little Boy held two masses of uranium-235 nuclear material at each end of a tube, and when an explosive charge fired from one end, it shot nuclear material toward the other end. With all of the nuclear material essentially combined into one explosive force, a nuclear chain reaction occurred and released enormous energy. This energy caused a massive explosion. Detonated over Hiroshima, Japan, during World War II, Little Boy was a gun-triggered fission bomb. It had a yield equal to 14,500 tons of TNT and leveled most buildings within 4 square miles of ground zero.

In an implosion-triggered fission bomb, explosives create a shock wave that compresses the core of the bomb. The fission reaction occurs, and the bomb explodes. Fat Man, which devastated Nagasaki, was an implosion-triggered fission bomb. It contained a

13.5-pound sphere of uranium-235 and plutonium-239 surrounded by explosives. When the explosives fired, shock waves compressed the plutonium, increasing its density by two. At this point, a nuclear chain reaction occurred, causing the bomb to explode.

Which brings us to fusion bombs, also known as thermonuclear bombs. These are far more powerful than either Little Boy or Fat Boy. Basically, the fission part of the bomb implodes, and resulting X-rays heat the inside of the bomb. Pressure causes shock waves that initiate the fission in a plutonium rod, which in turn gives off radiation, heat, and neutrons. Combined with high pressure and temperature, these neutrons are used to create fusion reactions, which produce even more radiation, heat, and neutrons. In a horrific cycle, the neutrons from the fusion create more fission, and round and round we go until the bomb detonates.

Even if Luthor dropped his bomb farther from Smallville, irreversible damage would occur. This damage would be in the form of (1) intense heat and fire, (2) intense pressure, (3) radiation, and (4) radioactive fallout. The fallout alone would enter the water, cling to the air, and be carried to far distances by winds.

A 1-megaton hydrogen bomb possesses 80 times the deadly power of 1945's Big Boy. Within a 1.7-mile radius of its ground zero, everything would be destroyed, including 98 percent of the people.[6] Within a 2.7-mile radius, everything would be destroyed, including 50 percent of the people, with 40 percent of the remaining population seriously injured. Moving to a 4.7-mile radius, most buildings would be destroyed, with 5 percent of the people dead and an additional 45 percent of the population seriously injured.

So what kind of bomb does Lex Luthor drop a mile outside of town? A stink bomb? It is impossible that Luthor drops a nuclear bomb outside of town and nothing much happens in Smallville.

If Lex Luthor is determined to kill everybody, we wonder why he doesn't use biological and chemical weapons. For example, a modern Luther would contaminate water or air with anthrax, smallpox, ebola, or other deadly biological diseases. Anthrax is a bacterium that was used during the 2001–2002 terrorist attacks on the

United States. Smallpox is a virus that is highly contagious and spreads quickly through the air. There is no cure for ebola, an extremely lethal virus that induces massive bleeding in its victims. There's also no cure for Marburg, another extremely lethal virus that causes hemorrhagic fevers. Botulism, a bacterium, can be inhaled or ingested; it causes paralysis and respiratory malfunction. Any of these biological weapons in the hands of an insane super-genius like Lex Luthor would mean death not only to all the people in Smallville but to those throughout the country, the world, and given the life-forms on other worlds in the Superman series, death possibly to aliens whose biology makes them susceptible.

The same is true for chemical weapons. If Lex Luthor really wants to kill everyone, then he should use nerve agents, toxins, and mustard agents. Basically, chemical weapons are lethal gases and liquids that attack the lungs, blood, skin, or nervous system. They are stockpiled all over the world. For example, one estimate places the Soviet supply at 40,000 tons.[7]

Luthor can pick from blister, vomit, choking, blood, mentally incapacitating, nerve, and tear agents. Or he can mix batches of chemical weapons that include varieties of deadly agents. Typically, medical symptoms occur within minutes or hours. Smallville would be decimated—poof, in no time at all.

But Lex Luthor is far more than a modern homicidal lunatic. According to "The Impossible Mission" (*Superboy* #85, December 1960), Superboy returns to the day in 1865 when Abraham Lincoln was assassinated. And whom should he find there? Why, none other than Lex Luthor! We later learn that Luthor has invented a time-traveling machine to escape—from prison, no doubt—into the past. After Lincoln is shot, Luthor returns to modern time, wracked with guilt, feeling responsible for Lincoln's murder. But is it possible to travel backward in time? As with the case of teleportation, the question of time travel is an old staple of science fiction, stretching back beyond H. G. Wells's 1895 novel, *The Time Machine*. In 1888, Edward Page Mitchell published a story called "The Clock That Went Backward," but few people remember him, whereas Wells's story will always be famous.

Today, it is almost universally believed that Wells's time machine could not be built as easily as he presumed. However, leading scientists are willing to admit the possibility, at least on a theoretical level, that backward time travel may someday be possible. For example, physics and astronomy professor Jeffrey Kuhn comments that "the notion you can move forward and back in time is allowed by some of the new ideas in physics."[8] And in the August 2003 issue of *Wired*, noted professor of theoretical physics Michio Kaku writes, "Once confined to fantasy and science fiction, time travel is now simply an engineering problem."[9]

Scientific theories about time travel are based on quantum mechanics and Einstein's theory of relativity. It was Einstein who first proposed time as another dimension of physical reality, with the speed of light being the absolute speed limit throughout the universe. Evolving notions of space-time pushed scientists toward pondering time travel via black holes, cosmic strings, and space-time warpage.

Think of space-time as a large piece of cloth held at each of four corners. An object—matter—drops on the cloth, and the cloth sags: it warps, it curves. In this case, matter induces space to curve. Now a second object—matter—drops on the cloth, and this second object rolls toward the curve made by the first object. In this case, curved space induces matter to move.

Now imagine that a huge object falls on the cloth. In fact, the object is so huge that it rips the cloth: the fabric of space-time is now torn. Think of the rip as a black hole.

In outer space, as large stars deplete their nuclear fuel, they shrink and become increasingly dense. This denseness increases the star's gravitational pull. Eventually, the gravitational pull is so great that nothing can withdraw from it; not even light can escape. Indeed, the gravitational pull is so tremendous that it causes space-time to warp and tear—just as the huge object dropped on our cloth caused it to warp and tear. This is a real black hole.

It is believed that time slows in a black hole. It is also generally theorized that somewhere within the black hole lies infinite density, where the laws of quantum mechanics are no longer valid. Anything entering a black hole is sucked into an abyss and obliterated. Anything coursing along the edges of a black hole—far enough from its center to survive—could very well enter time travel.

But keep in mind that this form of time travel may be to another region of this particular space-time, to another space-time, or even to another universe several space-times away. If you're cruising in a spaceship around the rim of a black hole and you enter time travel, it is unlikely that you can specify such a thing as "take me to the day President Lincoln was killed."

Kip Thorne, Feynman professor of theoretical physics at Caltech, explains that if you tried to travel back in time to change your parents' destiny, both you and the time machine would be fried.[10] His answer, however, is tongue in cheek. Professor Thorne, who lectures and writes frequently about time travel and black holes, speculates that at the moment the time machine was activated, it would be destroyed by an intense beam of radiation composed of "vacuum fluctuations of quantum fields." He bases this speculation on the laws of quantum fields in curved space-time. Yet he further says that right before the time machine was destroyed, the laws of quantum gravity would replace the laws of fields in curved space-time, that we know very little about the laws of quantum gravity, and that within this vast bank of unknown knowledge lies the answer to the big question: Can we travel backward in time?

Many scientists suggest that the warp/tear in space-time caused by a black hole actually spews energy into another part of the space-time fabric—that is, to another region of this particular space-time, to another space-time, or even to another universe several space-times away. This event is called a wormhole. If you drop into a wormhole and somehow survive, you theoretically could end up in an entirely different dimension. And if all universes and space-times are interconnected by wormholes, it'd be as if you dropped into the plumbing of your house: winding your way through a labyrinth of pipes connecting all these space-times until finally you emerged and remained stationary. At this point, you could possibly be on Earth in America on the day Lincoln was killed.

Of course, if time travel is indeed possible, and if we can travel from the future to the present, then why haven't we encountered any of our descendants? Nor have any of them contacted us. At least we don't think they have.

We could fill an entire book describing Lex Luthor and his scientific marvels. In parting, however, we should mention one of the nice things he tried to do. In "The Last Days of Ma and Pa Kent" (*Superman* #161, May 1963), the Kents become very ill and may die. The warden releases Lex Luthor from prison temporarily so that he can attempt to cure Ma and Pa Kent. He has invented a vibro-health restorer that destroys all symptoms of diseases and cures all illnesses instantly. Not only can Lex Luthor devise and use a dozen futuristic methods of death in one day, he can also invent cures for fatal diseases. Unfortunately, however, Luthor's machine does not work. And after only one hour of trying to be a good guy, Lex Luthor returns to prison. Is it a coincidence that in this one instance real science has its day?