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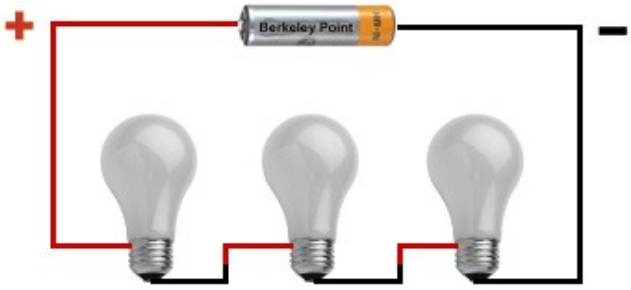
HOW a BATTERY CIRCUIT WORKS



by Miles Mathis

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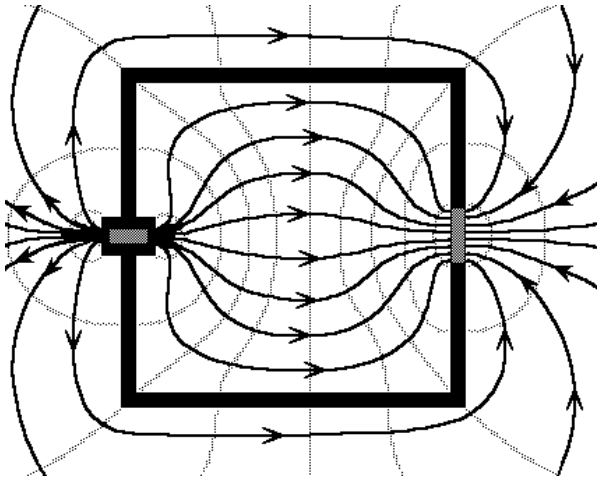
A reader sent me a link to an article from 2002 by Ian Sefton of University of Sydney, who tries to explain how a circuit works. This article is part of a Science Teacher's Workshop, and I must imagine that it is quite helpful in some ways, since it clears up a few longstanding and wide-ranging misunderstandings. However, Sefton's explanation of the circuit is still not mechanical, as I think he would admit. In this paper, I will clarify the circuit even further, by showing that it is the motion of photons, not electrons, that creates it. As we proceed, remember that all I say applies only to the battery circuit. We have lots of electric circuits, and it turns out we have to analyze each one separately. Some things will be the same, some things will be different.

Sefton divides current explanations of the E/M field into what he calls an accountant's model and a field model. I am not sure these are the titles I would have chosen, but we will work with them. Sefton rightly says that the accountant's model is just a mathematical model, one which explicitly and one might say proudly ignores mechanics. We simply do the math, and we ask no questions about how energy is transfered. This is the model most physicists have preferred in the 20th century, since it keeps graduate students quiet. This is part of the "shut up and calculate" model that has dominated all subfields of physics since the time of the Copenhagen interpretation. It is a sort of hiding of the E/M field and photon behind big walls of math.

Sefton prefers the field model, since it is a bit more rigorous. It makes some partial attempt to answer basic questions, questions that graduate students, and even highschool students, might have. This model comes from Faraday and Maxwell, and Sefton laments that large parts of it seem to have been left in the 19th century. No one much bothers with them anymore. However, if you read Sefton's field model closely, you will find it is almost as threadbare, mechanically, as the accountant's model. It attempts to show you more of the *effects* of the field, but it still gives you no causes. For example, any

smart highschooler must ask what causes the field. If it is not electrons flowing, what is flowing? How does the energy get from point A to point B? Sefton tells us it is charge differentials or potentials, but what are those? What is charge? When we have charge separation, what is separating? If it isn't electrons or ions, what is it? Einstein connected energy to mass, but we are told the field has no mass. So how can energy move across an empty field? Isn't that force at a distance? Sefton belittles the accountant's model for being like Newton's old force at a distance, but the field model falls to the same criticism. This may be why it has been left behind. Physicists figure, if you can't put together a good explanation, stick with the math. At least in that case the holes are not so noticeable.

Sefton's article dodges the fundamental and mechanical questions just as fully as any accountant's model. Can we fill in his field model? Yes, since we now have photons to work with. In a series of papers, I have resuscitated the old spinning corpuscle of Newton, or the vortex of Maxwell, updating past centuries more fully than anyone thought possible. Not only do I have photons to fill this mechanical hole, I have photons with mass, radius, and spin. In other words, I have photons with a lot of "quantum numbers." To see how the photon fills this hole, let us study a circuit diagram. If you read the page at Wiki on electrical circuits, you get the impression that electrons travel through the circuit, creating the energy transfer. Sefton shows us that is false, and I have nothing to say against him. His argument in that regard is convincing. The electrons are simply moving too slow. But if the flow of electrons isn't causing the lightbulb to light up, and if the field doesn't explain it either, how do we explain it? Let's look at what they call the Poynting flow:



[The battery is on the left. I couldn't borrow Sefton's diagram, so I found this one. To match Sefton's diagram, we turn the battery so the positive pole is up, and the top wire is labeled +].

As Sefton tells us, this Poynting field of energy flow S is found by multiplying the E-field by the B-field (S = E x B vector cross-product). That is to say, the electrical field and the magnetic field combine in this way to tell you the actual energy flow. Some may think that my photons just follow the Poynting vectors, but that isn't how it works. These vectors of energy flow are actually a misdirection. There is no real field S.

In fact, the electrical field itself is ill-defined, both historically and in this problem. Sefton tells us the electrical field in the middle of this circuit is moving straight down (in the diagram above E is the gray lines). But the electrical field is often simply defined as the way that electricity flows. In this circuit, the electricity would be in the current, so the field would point from battery to bulb, like the Poynting

vectors along the wires. If you define the electrical field like that, then it appears to follow S, not E. Curiously, Sefton himself later defines E that way, in this same paper. See below, where he lets E run through the wire.

I will show that Sefton is correct about the direction of E the first time. The photons do follow E, not S, and they follow the gray lines above (roughly), not the wires. This is because *charge is photons*. But he didn't need to bring S into it at all. To see why S can be ignored, we have to study the mechanics of this circuit a bit more closely, and in ways it has never been studied. I will show that neither the naïve mainstream model nor the Poynting model are correct. It is thought that the circuit acts as a medium through which charge can pass, but Sefton has already shown that isn't really the case. Whatever is passing is passing both through the wires and through the space between them directly, so it would appear that charge photons don't require the wires to pass to from battery to bulb. The wires would only appear to be giving the photons a reason to go to the bulb. They are providing some link, but they are not providing the path. How are the wires doing that? Well, in the first instance, we should read the wires as an extension of the battery, not as a path.

I will refine this explanation in a moment, but for now I will start with just a thumbnail sketch. If we think of charge as a density difference instead of abstract potential, we can clarify the mechanics here. The ionic content of the battery has set up not a separation of charge, but a density difference in the photon field. The photons are much denser on one side of the battery than the other. Why? It could be any number of reasons, but a common reason in normal batteries is that chemical reactions separate large ions from small ones. In other words, if free protons are pushed to one side and free electrons to the other, the protons will be recycling far more photons. Larger bodies emit more. That is one of the first rules of angular momentum. The photon density will be far higher on one side than the other, and by the rules of entropy or statistics, they will move from high density to low. We have a flow of energy. This creates the field inside the battery as well as the field just beyond it (there are no walls to the photon field). Now, if we extend wires to the bulb, we haven't provided the path to the bulb that the photons must take, since the photons need no path of that kind. They can travel directly if they like. What we have done is prime the field, like what happens in wireless transmission. The wires allow for an initial induction or matching of the present fields, so that photons leaving the battery can affect the photons in the bulb.

By this reasoning, we see that S is just the random movement of photons. The Poynting diagram doesn't explain the energy transfer or the mechanism of lighting in this problem; it is only the overall statistical motion of photons, with or without the wires and with or without the lightbulb. The battery is simply producing a lot of photons, more at one pole, and S (sort of) diagrams how they will leave the battery. The only difference between the S field above and a statistical diagram of photons leaving the battery is that S is diagraming only photons that go to the bulb. The diagram isn't interested in other photons.

Let me repeat: S is not the energy transfer of the circuit. I will show that charge photons mainly follow E, not S, as we would expect. S is the set-up *without* E. S is the circuit without the wires. So S = E x B is false. You can't build a path by multiplying E times B, since B is a spin. Linear motions make paths; but spins do not make linear paths. If we define S as the statistical motion of the photons of the battery, then a better equation is S + E = the path to the bulb.

That explanation is far from complete, but it gets us started. To fill it in, we go back to the diagram. From it we can see that it is not photons or electrons traveling from battery to bulb that creates the energy rise in the bulb and its lighting. It is actually photons moving *across* the bulb, just as they

moved across the battery. Because the photons are denser at the bottom of the battery, they will also be denser at the bottom of the bulb, in Sefton's diagram. Remember, the top wire is positive all the way to the bulb, and the bottom wire is negative all the way to the bulb. Although I have thrown out pluses and minuses in my own theory, Sefton is not completely wrong here. His pluses and minuses act to remind us that the electrical field is not moving straight across. It is mainly moving down, as I said above. To understand why this is, imagine that the bulb is more negative than any part of the battery. That doesn't have to be the case, but we will use it as the first example (and it does help). Statistics tells us that all the photons in the battery will be attracted to all parts of the bulb. But since density is spatial, it matters where the terminals are located in space. As the photons move over to the bulb, they naturally "drag" their old densities with them, simply because more photons will be coming from the denser areas. If the negative terminal is low, for instance, the density will remain lower a few feet away. Unless the circuit is gigantic, we wouldn't expect the density differences to dissipate much. Distances don't mean much to photons, remember, since they are moving so fast.

This is just to say that Sefton is correct when he labels the wire positive above the bulb and negative below it. The photons are indeed mainly moving up in the diagram, even at the bulb. Of course they must have some vector sideways, or they couldn't move from battery to bulb, but unless the circuit is extremely long, that vector will not much affect the electrical field. In an extremely long circuit, the photon vectors would follow neither the electrical field lines in these diagrams, nor the Poynting vectors S. The photons would move at some angle between the two, and we would have to redraw the magnetic field as well, to keep it orthogonal.

As a suggestion that I am right, I will remind you that the Poynting vector S is currently defined in a slightly different way than the way Sefton defines it. He says that S is the direction of energy flow. But if you check the latest theories, S is more strictly defined as the change of energy *density*. You should find it interesting that current theory uses density here, since I am defining the entire circuit, at the fundamental level, as an outcome of photon density variation. If you read the current theory, the question is begged, "density of what?" The field is given an energy density, but fields can't have energy or density. Rigorously, a field has to *contain something* that has energy or density. Current theory hasn't assigned the density to anything. The density is just a floater. I assign the density to photons.

Let me expand this idea a bit, for those who don't see what I mean. If you say you have a field, that implies a field of somethings. Otherwise, a field is just an abstraction. If you are a farmer and you say, "I have a field," I may ask, "a field of what?" The field must contain something, either barley or corn or grass or at least dirt. Likewise, in physics, before the modern age a field was always a field that contained something. To remain mechanical, the field must contain something, either atoms or molecules or electrons or asteriods. The field concept allows for a mathematical shortcut with very small particles or lots of particles, since we don't have to bother measuring the forces on each particle. We create a field that represents sums of these particles. In that case, the field concept was justified. But the field concept is *not* justified when it is used to dodge foundational questions. It is not justified when it is used to pretend that you don't need anything in your field. This is what modern physicists do (I say modern, but it started with Faraday). They create a field, make it mathematical only, then jump on you if you ask them what is in their field. They yell that you are asking metaphysical questions and that you should go back to the philosophy department. But they are wrong. Asking what is in the field is not metaphysical, it is physical. They need to check the definitions of words, which they appear to have forgotten. Asking what is in the field is a mechanical question, and mechanics is physics, not metaphysics. I know this because I studied philosophy as well as physics. I have also read the dictionary, so I know what words mean.

Now, let us return to the circuit. Sefton contradicts both my analysis and his own previous analysis in section 4.5. There he tells us that energy transfer S is directly into the wire on its surface. That is because E is forward through the wire. Disregarding his math for the moment, let us look at the logic of that. In his larger diagram, he had S following the Poynting vectors, as above. Which means that S is traveling through the wires, not E. He has drawn E pointing down across the entire diagram, from pluses to minuses (see his figure 7). He can't have it both ways. In addition, we can't have equal energy entering the wires from all directions. That would create zero potential in the wire, wouldn't it? He encounters the same problem when he says that energy transfer S follows lines of equal potential. Notice how the S vectors (black lines) in the diagram above follow the equal potential of E (gray lines). That doesn't make any sense. Why on Earth would energy move from one area of equal potential to another? That negates the whole idea of potential.

You see, not only do physicists not know what "physical" and "metaphysical" mean, they don't even know what "potential" means. The idea of potential was created to explain motion without a push or a pull. Potential is another field of numbers, and the number differences stand for impulse to motion. In other words, if your numbers are different, the motion of a particle placed in that field is implied. Particles move from one number to another. But particles do not move from one number to the same number, because those are equal potentials. There is no impulse to motion in the field between two numbers that are the same. Therefore, saying that energy follows lines of equal potential is like saying that water flows up. It is a contradiction. Seeing physicists who don't know what potential is is like seeing plumbers who don't know what a pipe is.

I will be told, "No, the potential Sefton is talking about is in E. S is following equal potential of E. There would be a problem only if S were following equal potential of S." But there is still a problem, since none of this energy has been defined, neither S nor E nor B. Since we have three variables, we have three fields and three potentials. Energy is moving or can move in any of three different ways. But the current theory does not tell us what is setting up any of these fields of potentials, or why a charged particle placed at any point in the triple field moves one way instead of another. According to current theory, some nebulous energy or density is moving in the field of S, although we aren't told why. At the same time, E is moving down, so a negatively charged particle should move up. Why does the charged particle follow E and not S? The energy in S must not be charge, because charge follows E. If it isn't charge, what is it? It can't be charge density either, since charge can't move one way while its density moves another way. If you have a field of electrons and they are all moving north, their density can't be moving west.

Finally, if E is moving down, then what is drawing charge to the bulb? The bulb isn't down, the bulb is to the right in the diagram. Charge is going up, so what is going to the bulb if it isn't charge? I can answer these questions, but the whole Poynting diagram is just further misdirection and obfuscation. Unassigned variables E and B weren't enough, so someone had the brilliant idea to add a third unassigned variable S.

Let us return to Sefton and his S going into the wire. Does this idea make any sense with my theory? In other words, could we propose that photons always move into the wire? This would certainly energize the wire, but it wouldn't explain any of the movement of energy. If S somehow causes both E and B, then how could S moving into the wire create a directionalized E, down the wire?

Sefton will say that it is not S that causes E and B, but the reverse, but he still has a big mechanical hole. He takes E as given, when it is what we are trying to explain. That is called begging the

question. IF E is moving along the wire, WHY is it doing so? My theory explains it, his doesn't. Besides, he told us earlier that current wasn't defined as moving electrons. If E is not moving electrons, what is it? He tells us it isn't energy transfer or flux, either, since he has assigned that to S, not E. So E is unassigned.

In my theory, there is no S, so I don't have to explain it. There is only E, and E is the linear motion of the photons. In my theory, neither S nor E are moving through the wire. As we will see below, some photons are initially moving in the wire to prime the field, but this movement isn't either S or E. It is a precursor to E, just as priming the field is a precursor to transmission in wireless. And yes, electrons may be caused to drift by collisions with these passing photons, but, as Sefton just proved, E cannot be this movement of the electrons, since it is too slow. The drift of electrons is just a side effect. The drift of electrons doesn't light the bulb, so it isn't what we are concerned with.

We can see this just by looking at the top wire in these diagrams. In the naïve circuit model, as at Wikipedia, we are left with the impression that something is completing the circuit. That is, we think the electrons go over to the bulb by the low wire and then return to the battery by the high wire. That would be the only way to complete a circuit. To have a circuit, something has to travel that circuit. If you don't have something going round the circuit, you only have two parallel paths, you don't have a circuit.

Even the mainstream knows that is not right, since many diagrams on the web label the high wire as the hot and the low wire as the neutral wire. If we had a true circuit, then both wires would be hot.

But even in Sefton's field model, nothing is completing the circuit. The Poynting lines are all going from battery to bulb, both top and bottom. No S lines are returning. No energy is coming back, so there is no circuit. These diagrams are labeled as circuits, but they are pseudo-circuits. No circle is created. We could say the same for E. In Sefton's diagrams, there is no circuitry or closed loop of E. E just moves down from plus to minus.

If this is the case, we must explain why we even need to complete the loop with the second wire. We know that we do, since if we don't, the bulb doesn't light up. Why? A related question is why we need the wires at all. My photon densities should be moving over there regardless, since photons are not contained. I went some ways to explaining the second question above, but I will hit it again now, with much more rigor.

As I do that, remember that we do have wireless transmission of energy now. Tesla gave us that, and we have known about it since he lit his bulbs up in the ground, almost a century ago. So although the common reaction then was surprise that we don't need the wires, the common reaction now should be surprise that we *do* need the wires. Therefore, if we are asking why we need the wires here, it may help to look at how wireless transmission works, to see why it isn't working here. Don't bother going to mainstream sources like Wikipedia to learn about wireless, unless you are already an expert on coupling and induction and so on. As usual, they hit you with so much misdirection your first reaction is to assume they don't even know what they are talking about. And it is quite possible they don't. When I read stuff like that I start to assume they are just following plans that Tesla left them, and that nobody even understands how it works to this day. Since we have already seen that neither the accountant's model nor the field model can explain the mechanics of a simple wire circuit, we may assume that they also know nothing about the fundamental mechanics of wireless. That is, as usual they know the engineering well enough to make the toys, but they know and care nothing about theory. That is why when it comes time to explain the mechanics to laypeople or even graduate students, we

get nothing but hemming and hawing.

In a nutshell, in wireless transmission source and receiver have to be coupled, which means the field in the receiver has to be primed to match the source. This priming is done via the E/M field between the source and receiver. Since the Earth's atmosphere is already an E/M field, it can easily be used for this purpose, as Tesla discovered. The problem is, in normal conditions, the field is not coherent in any way. It is scrambled, relative to source and receiver. Charge photons are rushing around in every direction. But by sending out a pre-signal, as it were, a path is created for the photons. A coherence in the field is created. When this field reaches the receiver, the E/M field surrounding the atoms there is also made coherent. This coherence can be a coherence of frequency or it can be a coherence of spin (magnetism), or both. This means that the charge emitted by particles in the receiver will be as like as possible in type to the charge emitted by the source. Like charge couples most easily. Charge that is directionalized, frequency matched, and spin matched will maximize the coupling. That is a very simplified overview, but it will give us what we need to continue.

With this in mind, we see that the reason there is no wireless transmission between a battery and a bulb is that there is no pre-signal. The field hasn't been primed. The photons at the source don't match the photons at the receiver in any way, so there isn't any appreciable coupling. And this means that the wires in a wire circuit aren't really carrying charge, they are simply priming the field. The wires supply the pre-signal. They mirror the function of the conductor in wireless. Some amount of photons pass through the wires, and they cohere the E/M field inside the bulb. This causes a sort of mutual induction, although most of the effect is going from battery to bulb (since most the photons are being recycled in the battery). And since the heaviest photon traffic is from battery to bulb, this traffic will cause the electrons in the wire to move toward the bulb, by direct bombardment. This is what has fooled everyone. They see that electron movement toward the bulb and mistake it for the mechanism. It isn't the mechanism, it is just a by-product.

But why must we have two wires then? Why doesn't one wire work to prime the field? Because one wire doesn't allow for induction. Induction is caused by photon modulation of some sort, and you can't have this modulation without some appreciable width of influence. If you had a really wide wire and a perfectly directionalized connection, you could create the induction with one wire, since in that case you would be mirroring the wireless set-up. In wireless, the atmosphere works like a really wide single wire with a pre-existing field. But a normal copper wire is too small in cross section to allow the photons to arrive at the source with the proper information. You can send information through a single wire, but you can't prime the E/M field through a small single wire (under normal circumstances). To simplify the mechanism for this paper, think of the photons arriving at the bulb and speeding out of the wire. Following Huygens principle, we can imagine the photons fanning out, as from a point source. That fanning out ruins the ability of the photons to cohere the field inside the bulb. The local field can't read what the new photons are trying to tell them, since the fanning out is changing the information every moment. If the field is supposed to be modulated by frequency for instance, that fanning out is changing the frequency. Photons coming out near the edges of the wire—the ones fanning the most—will be shifted relative to the local field. The field inside the bulb doesn't know what to make of the new photons. Very little of the field inside the bulb will be modulated. Induction requires a resonance, and a fan can't create this resonance.

But if we allow even two point sources to enter the bulb simultaneously, with some separation, the local field can read the information in the new photons. How? Because the two new fans will cross. One new influence won't create a pattern, two will.

Remember that waves are basically very simple fixed patterns. It is these waves we are modulating in some fashion to create the induction. Well, a fan doesn't create a new pattern or wave that will stand. A Huygens fan just looks like a stirring to the local field. If anything, it will decohere or mix the field inside bulb, not modulate it. But two such fans create crossing points that make a consistent pattern. This pattern can be read as a wave by the local field, and the local field can therefore be influenced by it in a positive manner. The field in the bulb can therefore be made like the field in the battery, and we have induction. That's a raw explanation, but I think it gives you the picture more clearly than any of the other explanations I have seen.

I have a couple of things left to explain. I have said that the wires simply provide the induction. But if that is so, then why does the induction cease when the wires are cut? According to my theory, shouldn't we have wireless transmission after the initial priming, even with a battery? No, of course not. In real wireless, do we continue to have transmission when the conductor is turned off? No. The reason for this is that the ambient field rushes back in in both cases, rescrambling the paths. The coherence has to be maintained or it will immediately be lost. We can imagine E/M fields that might maintain this coherence even after the wires were cut or the conductor turned off, but the Earth's atmosphere is not such a field. For one thing, I have shown that the Earth's field has heavy photon traffic straight up, everywhere on the surface of the planet, and this traffic is going to interfere with any photon motion that is not also straight up.

In addition, it might seem that by my theory, both wires would be hot. Since photons are moving from battery to bulb in both wires, why don't we see electrons moving the same in both wires? Because, again, the two poles aren't the same, as a matter of photon density. We have a much larger density at one pole. That is what created the initial energy field in the battery. The photons moving to the bulb from that pole will be much denser in the wire, and will make it much hotter. This means that the neutral wire is not really neutral, it is just relatively neutral. It is a lot “cooler” than the other wire, because very few photons need to move through it to create the induction. Therefore, we would expect some motion of electrons toward the bulb, but not much. This sharply contradicts current advice on the web, which states that the neutral or “return” wire completes the circuit, returns the charge, or whatnot. The neutral or return wire in a battery is not a ground, so nothing is returning and nothing is neutral. If electricity was returning to the battery, the wire would be hot in the other direction, right? And the same applies if it was a ground. The neutral wire could work as a ground in extreme circumstances, like if your battery exploded or had a big charge surge for some reason. But under normal circumstances, we would actually expect the electrons to be moving very slowly *toward* the bulb, which means we have neither a circuit nor a return nor a ground. The only reason you would find electrons moving back to the battery is if you are overloading your bulb. But in that case, the electron reversal would imply a photon reversal, and that would break the induction. Your light would go off.

Now I will answer a question from a reader. He asked, “How can S + E = the path to the bulb? Haven't you already said (in other papers) that E is the linear motion of photons? That would make S and E the same thing, which would give you 2S or 2E.” Good question, if stated a bit provocatively. S is the statistical linear motion of the photons, *before* we prime the field. It is the linear motion before the induction and before the “circuit” is created. After the mutual induction takes place, and the fields are cohered, then E will be created. The upward motion of the photons from one pole to the other in the battery will be pulled out of the battery over to the bulb, where it will still be moving up. E is the motion up, S is the motion in all directions, which add to give us the motion of photons from battery to bulb.

Conclusion: We now know some things we didn't know yesterday. 1) The motion of the electrons in

the wire is just a by-product. It is not the mechanism that lights the bulb. It is caused directly by the motion of photons. 2) The map of Poynting vectors is mainly misdirection. The E/M field has only two components, not three, and they are caused by the linear motion of photons and the spin of photons. This means we must recombine E and S. 3) Energy cannot follow lines of equal potential. And you should not define motion in one field by the numbers in another field. S, if it existed, would follow its own potential map, not the potential map of E. 4) We must have photons in our field to explain anything mechanically. A field with nothing in it but math is an awful nuisance, it is not physical, and it scrambles the brains of any who come in contact with it. 5) Anytime you have information that moves at the speed of light, you should assume you have photons involved, not electrons. Hard to believe we didn't know that yesterday. 6) Potential differences in this problem are actually variations in photon densities. Rather than think of potential, we should think of wind. But here, we let our wind vary in density, not speed. 7) Like everything else, electrical induction is a mechanical process. It is photons colliding with other photons, and informing them via a resonance; just as one river entering a larger river will be informed by that river (as a matter of speed, say). 8) The wires in a simple circuit perform precisely the same field priming that a conductor does in wireless. That is, the wires produce the initial induction, and after that, the field of the battery can pass to the receiver with or without the wires.

And finally, we have learned that different substances actually create different charge. We can deduce this just from the fact that we need induction. If all elementary particles and atoms and molecules were emitting the same charge photons, then we wouldn't need induction. The photons in the battery would already match the photons in the bulb, and we would have wireless connections between everything, without wires and without conductors. We wouldn't need towers creating paths; everything would be resonating with everything else, and it would be a mess, frankly. So we have discovered that different substances emit different photons. The size and shape of the emitters determine the characteristics of the charge. This means that we might create induction, or maximize it, by making our receivers out of the same material as our emitters. In some cases that might be impossible. For instance, if our source of emission is free protons, it would be hard to make a lightbulb out of free protons. Even hydrogen wouldn't mimic free protons, since the shape would be different. But it might be possible to make a battery and a bulb out the same materials, or out of materials that created charge of the same profile. Just an idea.

It might also facilitate transmission to have the receiver directly above the source, so that the charge field of the Earth will help rather than interfere. The difference might be small, but it might also be measurable.
