

MAGNETIC FIELDS SURROUNDING CONDUCTORS

By
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OPENING:

As a requirement to study and then receive a degree in Electrical Engineering, there is required a course in physics. The first thing in their first class the EE students are informed is to forget what you were taught about electricity and magnetism in physics as most of it is wrong. But that is only part of the problems.

There are words used in both physics and in EE that are not only wrong, or incorrect , or misleading, but many entities there were given mathematical signs that causes yet further misunderstandings and impossibilities. It is not the purpose of this paper to give all of these as a few of the more important will be shown as this discourse is expanded. The only comment is; neither of these disciplines will change anything even when they know they are wrong nor will they get together and make all of the corrections and start all over. It is the students and truthful science that lose.

For brevity, only the last names of the scientists involved are given. They should be known to the readers. There is given at the end the usual references. Only the fundamental information will be given. There are NOTES that will reference these specific books by page numbers and to others involved. It is recommended that the reader stop and read the referenced NOTE before proceeding.

What this paper is all about are the unbelievable errors, omissions, falsities etc. that are now shown in textbooks and references for physics. Those that are in the EE texts or might be are so noted when applicable. See NOTE [1]

SPECIAL NOTICE:

The magnetic field of the Earth is the chosen human frame of reference against which all of the magnetic phenomena were compared to. This made such relative and not absolute. This resulted in that what is called the N pole of a second magnet is actually emitting its opposite field and likewise for the S pole. And as usual, the scientists based the distinction on the visual effect and not on reality or backwards. That is, a magnet used in the compass should have had its pole that pointed to the N of the Earth marked S as unlike poles attract. Instead it was marked N and remains to this day. For practical purposes then anything written as to magnetic phenomena is actually backwards but is not incorrect to the Earth's poles' frame of reference. It will be shown later that the created poles are not relative but absolute.

1: WHERE IT ALL STARTED

From the previous study of electrostatics, though unfortunately it was not wholly true but close enough, that there were two kinds of electricity that were named from their source *effect* vitreous and resinous. Franklin from his study of electrostatics determined that there were not two different kinds of electricity, but only one with two effects. His first double mistake was to designate the two effects as positive and negative and assigned a mathematical sign to same. It is unfortunate he did not use V and R even if that was a stretch of the imagination. His next and biggest mistake as he had a 50-50 chance on this one, that this one kind flowed (moved) from positive to negative. From that point on the study of moving electric charges became downhill and has resulted in the near total garbage taught for over a hundred years about electricity and induced magnetism due to electric currents in conductors in physics.

This will have to be discussed in further detail later, but for the present, the flow of electrons from the source is the negative terminal, output, to the positive terminal, input. This causes confusion as in almost all of the textbooks so referenced, only the input current as “*i*” is shown and NOT which direct current source terminal. Hence, if they are following tradition, the source is positive and some of the illustrations are in error. If they are using the correct source as negative, then some are correct. Hence, the scientists for all theoretical purposes have **bypassed reality** 100% by giving *only the end results*, without having to commit (cowards) to either the falsity or the truth. The author assumes herein that they were using the positive source as the input current or practice what they preach.

2: THE CRUCIAL DISCOVERY

Prior to 1831 there was another known of two different kinds of electricity effect electrostatic (static) and moving. The moving was done when the static source was sent through a conductor like a wet string or the human body. The static form could be stored in the Leyden jar and rapidly discharged. The behavior of magnets had been known from antiquity and many experiments (independently done) had shown that a magnet had two poles. A bar magnet or a sphere, was such that one of the poles turned to magnetic North of the Earth’s field and one the magnetic South. These field lines’ directions were what is equivalent to the reference longitude lines of the Earth, i.e., great circles passing through the magnetic poles. It was arbitrary that the pole that pointed to N was named the north seeking pole and became just the N pole eventually. Many suspected that there was probably some direct connection between electricity and magnetism.

In 1831 Oersted discovered that a straight conductor (here on in a wire may be used) caused the needle of a compass (needle here on in with the N pole normally painted black) to be deflected by the current in the wire. This then showed the connection between moving electricity, not static electricity, and magnetism. It is from this fundamental discovery that all the present behavior of batteries and conductors is derived and the entire electrical power system. It was Volta who made the first bimetallic battery so to speak that gave a useable controlled continuous direct current.

A diligent search of the references did not immediately find Oersted’s actual experiment. It was only mentioned like an afterthought. Then the author used Reference 1. that was his college textbook and found it on page 389. There was one thing wrong. The text explanation did not match the illustration. A quick search on the web resulted in a dead end for all practical purposes.

Then the author started looking in all of the references, those which had an illustration and discovered that for the most part, the illustrations did not have any input or N and S poles likewise, especially for solenoids. See NOTE [2]

Then the author became very suspicious as to why not the direct current source, the input current, and the N and S poles not shown but only the verbiage end results? Something was wrong somewhere. Sic: Sherlock Holmes and the dog not barking.

But, the most glaring lie by omission was; in **NONE of the references was there mentioned in which direction** was a coil wound and that included a single coil or a loop.

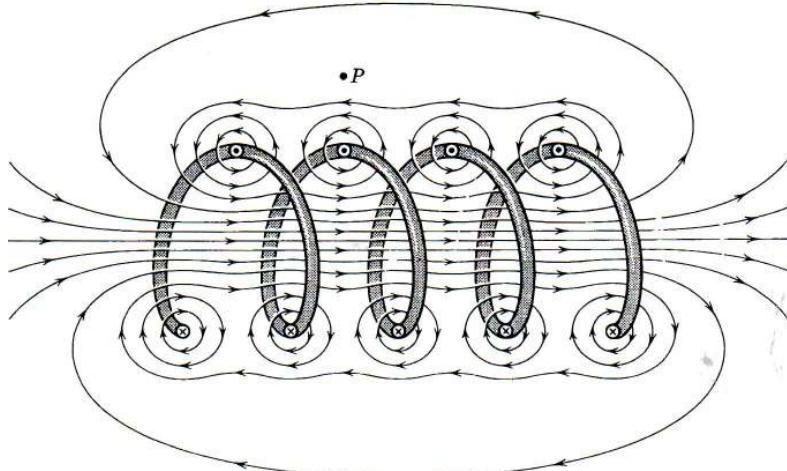


Figure 1

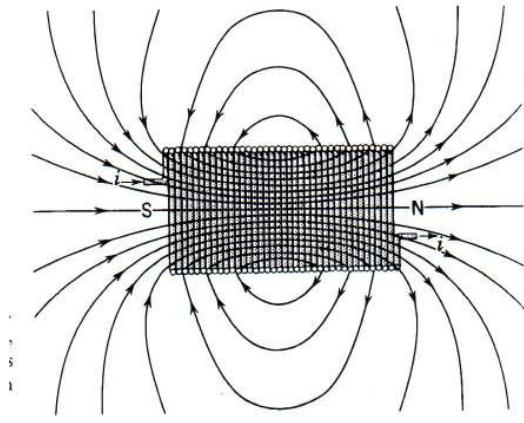


Figure 2 (a)

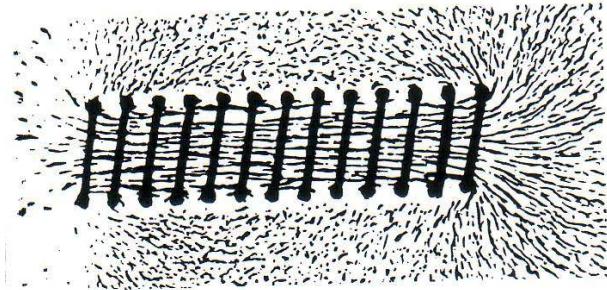


Figure 2 (b)

The field within a long solenoid is uniform; outside it is essentially zero.

Credit: Figure 1, 2 (a) Reference 6. Figure 2 (b) Reference 7.

Not being able to find the answers the author decided to perform the experiment (or close there to) that was done by Faraday using a solenoid circa 1833. See NOTE [3]

3: DUPLICATING THE EXPERIMENT

The author reproduced this experiment using a solenoid about 58 cm long and 4.5 cm in diameter that was the remains of the secondary of a Tesla coil the author built probably 40 years ago. The power supply was a D dry cell battery in a holder underneath the middle parallel to the coil and taped in place. The entire solenoid and battery was suspended from a string about 130 cm long. The experiment was performed in the author's work shed that has his laboratory. The apparatus was assembled on September 24, 2006 in the AM and the experiments conducted starting from noon until about 4:00 PM.

Since there are two possibilities as to which terminal to which wire end and which direction the coil is wound, that gives 4 possibilities. Therefore, using hindsight the negative terminal was considered as the input. The coil was then wound when one looked at the end in a clockwise direction.

One wire from one end was to the positive terminal and the other wire to the negative terminal. Since the oscillation time was very long, it took about 30 minutes for the solenoid to line up with the Earth's magnetic field.

When the apparatus had stabilized, the positive terminal was facing south so that meant the other end was the N pole and was the negative terminal input, not that as shown in the book illustration that had it reversed. Therefore, the book illustration was wrong or false. To further verify the results, the N pole of a magnet was brought near the coil and the attraction or repulsion as applicable was verified.

The next step was to insert a straightened out wire from a coat hanger that was the length of the coil into the coil to increase the field strength. The coil continued to face the N and S poles as before so that did not change the direction. Then the battery was removed and reversed so that the terminals were reversed with the negative terminal now facing south. The coil then swung around reversing its ends so that the negative terminal again faced north and the positive faced south.

Though this experiment was not done, from previous results had the coil been wound counter-clockwise, the reverse would have occurred.

Once this experiment was done, then the falsities, bad illustrations etc. could then be found and the effect of the flow of electrons through wires finally determined and the whole truth became apparent.

The forces and effects can now be arbitrarily finitely defined that has been left out of all references. Since there are four possible combinations (that is arbitrary) the correct flow of current will be used or from the negative to the positive terminal. The choice of the direction of the winding was clockwise when viewed from the end by the observer. That then made it absolute. These choices will be obvious from further end results.

I: When the current input is from the negative terminal of the source and the wire of the coil is wound in a clockwise direction when the observer is facing that input end, the exiting field pole will be N and the opposite end the S pole.

4: ELECTRON FLOW

A. THE LAST CHANCE

Faraday studying the currents came to the conclusion from their effects (electrolysis that he named etc.) that the wire that attracted metal when electroplating was done or gave off hydrogen from liquids (water) that he named the **cathode** and was the negative sign. Then the other wire he named the **anode** and was the plus sign. Hence the terminals of a battery or to some specific apparatus should have been designated C and A with *no signs needed*. It was a lost cause. See NOTE [4] The effects would be attraction (A), null (N), or repulsion (R) and again, no signs required, i.e., $C \leftrightarrow C = R$ or $A \leftrightarrow C = A$ or at the midpoint between, $C \uparrow\downarrow C = N$ or $A \uparrow\downarrow C = N$ etc.

B. DISCOVERY OF THE ELECTRON

In 1897 Thomson discovered the electron and it was given the negative sign and hence became a negatively charged particle. See NOTE [5] There is no and cannot be any flow in a conductor using a positively charged particle. The mirror image of the electron the positron that was given the positive sign annihilates upon meeting up with an electron. The hydrogen nucleus is called a proton and has the positive sign and cannot flow either through a conductor when isolated and neither can any other known charged particles likewise.

II: Therefore, excluding a particle itself, *there is no such thing as a positively charged area or surface.*

III: There is NO POSITIVE FLOW IN NORMAL CONDUCTORS AND ALL ELECTRICAL CURRENTS ARE NEGATIVE; PERIOD! See NOTE [6]

5: FRAMES OF REFERENCE

Ampère from his study after Oersted's results were disseminated came up with, based on Franklin's flow and wrong direction, what is called the right hand rule. When the thumb of the right hand shows the direction of the flow, then the curled fingers shows the direction of the magnetic field *based on the N pointing needle*. But, due to the fact the human eye is above the hand, then what was understood but was not and never has been spelled out; *the right hand rule is when looking down*; vertical or horizontal understood.

Scientists are extremely sloppy when it comes to defining most anything. They forget that most of the experimental results depend on what the human operator sees. Therefore, all such are **relative** and not generic. What is seen depends on which end is viewed or from which direction when shown on the normal paper such is printed on. A classic example is the supposed field shapes surrounding a straight conductor. Using the right hand rule, the current in from the bottom of the view the field curves to the left or counter-clockwise when viewed "down". When viewed "up" the field curves to the right or clockwise **based on the arbitrary way the N pole is pointing**. Therefore, it cannot be said that the field curves either way specifically. A compass placed in the horizontal plane when the current is entering from the bottom causes the needle N to point up when on the right and down when on the left or in the direction of the field (shown by an arrowhead). But when viewed from the bottom looking up, the field and pointing is reversed from that frame of reference.

This relative point of view then results in the left hand rule that is the opposite to the right hand rule. Simply, looking down against the source for a vertical wire, the right hand rule applies. To see the other side **if** one were looking up or in reality, then the left hand rule applies and vice versa.

Going back to its original discoverer Oersted, there will be a single wire drawn from left to right with the negative input on the left end. See Figure 4. A compass's diameter horizontally placed above the wire and looking down, the needle will show the N pole turning to the left or towards the input side. When the compass is placed under the conductor, the reverse is shown or the N turns to the right or in the opposite direction. The illustration in Reference 1. was wrong for the under the wire compass as per text.

When there are two parallel wires they will be repelled when the relative input for both is negative or positive. When one input is positive and one is negative, they will be attracted.

When the compass itself is in other planes like being placed vertical and in line with the wire or Earth's field, the needle moves down called dip; 90 degrees down at the magnetic poles and none at the equator. The action is obvious and needs no further discussion.

6: THE SINGLE TURN (LOOP) WIRE

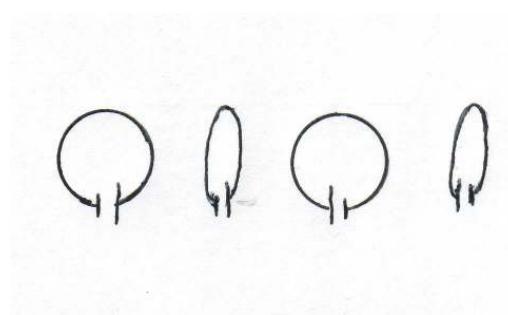


Figure 3 (a)

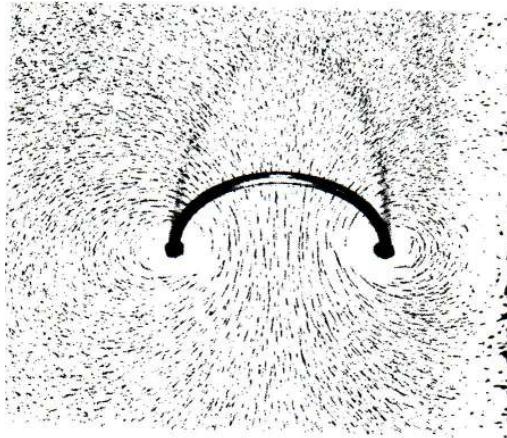


Figure 3 (b)

Credit: Figure 3 (b) Reference 7.

But, what about one single turn of wire? It makes no difference. See Figure 3 (a). It is the input terminal so that for a single coil, when the input is negative (consider the battery source is very thin and the turn's ends terminate at said battery *at the bottom*) so that when viewed along the wire (at right angles to viewer) the N will be to the left and the S to the right. Rotating the loop so that the positive terminal faces the viewer the S is to the left and the N is to the right. An observer on the opposite side sees this in reverse. That was why the author chose that particular one out of the four possibilities for his definition. There is no finite clockwise or counter-clockwise frame of reference.

IV: What is most important is that this single turn shows that the electrons must leave the negative terminal and flow to the positive terminal and so the right hand rule is true and correct.

That is, even though Franklin was wrong, though a miracle if there ever was one, Ampère's right hand rule was true or right for the wrong reasons.

But only Reference 9. on page 611 FIGURE 19.25 (a) (a ring with the arrow showing the flow of current down towards bottom of page) has the correct fields. That is when viewed head on as per the figure with S to left and N to right, i.e., the positive terminal of the "imaginary battery at the bottom" faces the observer.

7: MULTIPLE TURN COILS

The coil may be wound in a spiral for the single turn and behaves in the identical way to the single turn. The solenoid may be wound in multiple layers and/or its diameter varied over the length of the coil that does not change its magnetic field direction.

8: RIGHT HAND-LEFT HAND RULE FOR SOLENOIDS

Hold the left hand vertical in front of eye with the thumb at right angles facing the eye. Curl the fingers as usual. The first finger is the direction of the windings of the coil that is clockwise. The input is to the tip of the thumb from the negative/cathode.

The N field exits in the direction of the thumb or towards the eye. The opposite end is then S. It is obvious that when the coil is wound counter-clockwise, it is the opposite. However, for the left hand repeat and the fingers curl counter-clockwise the input is to the tip of the thumb from the negative/cathode and the S field exists in the direction of the thumb.

For a single turn coil, hold the left hand with the palm facing the eye. Move thumb in 90 degrees so it faces the eye. Curl the first finger into the letter c that is clockwise. The tip of the thumb represents the negative/cathode as the actual or imaginary source at the bottom facing away from the eye. The positive/anode is then facing the eye. The current then flows in and around so that drawn as an arrow, it faces down after passing the top of the coil and into the positive/anode. The S is to the left and the N is to the right; Figure.3 (a) far right view. For the opposite, use the right hand and the tip of the thumb is the negative/cathode actually facing the eye at the bottom. Then the N is to the left and the S is to the right. Figure 3(a) second from left view.

And that is why per **6.** there is no finite direction of the single turn coil as it is a human concept observation.

9: THE PROBLEMS

To the best of the author's knowledge from years of research, there is something that is never mentioned or if so, glossed over and hopes it will be forgotten. To keep this particular paper simple, **only** the electron is being used. But keep in mind that the movement of any charged particle results in the magnetic field moving AND most important, when said particles are not in a conductor or moving in space, there is also their moving electric fields. That creates an entirely different discipline and will not be considered here. When the electrons move (flow) in a conductor, there is **no electric field beyond the surface** of the conductor.

V: The charge of the electron has no bearing on the flow of the current in conductors.

Simply, placing a wire having a flow near some charged insulators, will not cause said insulators to move or be attracted or repelled by that flow of current. So, what happened to the electric field?

VI: None of the three known fields that of gravity, electric, and magnetic cannot and do not have any effect on one another.

At this point the author will state what has long been censored out of all references and much less put into textbooks for students.

#1: The electrons flow or leave the NEGATIVE terminal and move towards the positive terminal.

- A. Remember the law or rule for charges? Like charges repel, unlike charges attract. Hence, the electron was given the sign of negative charge and so it cannot leave a positive terminal and cannot be attracted to a negative terminal.
- B. For most purposes the old opposite falsity is innocuous. But by the same token it can and does cause injury and even death when car batteries are incorrectly connected with jumper cables. The same goes for certain electronic circuits that must have the proper connections or they won't work.

#2: The quantum **flow** of electrons in a conductor create or cause that **whole numbers** of same flowing past a given point in a unit of time, to be called the current (volume and hence density). Its unit of measurement is called the Ampère.

Simply, what has been taught or implied (long removed from textbooks) is the incorrect flow of electrons from positive to negative that has been known to be wrong for over a hundred years with the discovery of the electron and it correctly given the sign of negative or negative charge. Even the word flow or anything suggestive of such is prohibited to be printed or taught. Every illustration this author has ever seen in **any** first year physics textbook has an illustration or equivalent with normally a black arrow pointing in the WRONG DIRECTION. Even what this arrow means is not given besides. Shame!

How these electrons flow is not known. What is known is that they travel through a medium they have a speed slightly under the speed of light, when they encounter resistance they create heat in the conductor, and they create a magnetic field that surrounds the conductor. When extremely small resistance is encountered, they do lose energy extremely slowly and create heat, i.e., superconductivity. This movement of the electrons can also be modeled as a wave instead of as a solid. There is probably some truth here as any moving mass has associated with it at all time, it's associated de Broglie wave. However, the de Broglie wave is not a true wave, but that leads off into a side issue that is not for here.

10: WHICH WAY DOES AN ELECTRON FLOW

The electron will be considered here as a sphere having a finite diameter. The electric field extends from *its surface* outward from its imaginary center reference point in straight forward lines perpendicular to the surface to create the electric field. The field's speed of propagation is unknown, but will be stipulated that its **effect speed** moves at the speed of light. Any rotation of the electron does not cause the field lines to curve but move in toto with the moving electron. The APPARENT effect does plot out as curves (spirals) that is vastly different. The only effect of the electric charge is to provide the pressure (voltage) to repel the one in front of it through the conductor from the negative terminal to the positive terminal which attracts it.

The magnetic source is identical to a bar magnet. The field lines do not originate at the ends but at some point inward from same. Call this the pole hole. In an electron these pole holes must be less than about 2.4×10^{-12} m apart. The end result is that the electric field can be considered as similar to the Earth or the field lines wrap around it in a longitudinal direction. Hence the effect is as if these lines were a thin disk due to the electron's speed and are shown in the illustrations as concentric circles around the conductor. See NOTE [7]

In order for a bar magnetic to have the associated field shape then the poles of the electron must move in some finite direction and then be fixed to create the field lines. It is known that the electron poles in a bar magnets are aligned so that their N pole points into the N pole hole and then others go out from said pole hole into space. The same holds true for the S pole and its pole hole.

Therefore the N pole points in the direction of motion (ABSOLUTE!) and the S pole trails. It is obvious that the electrons' poles cannot move at right angles to their path through the conductor.

It is the right angle effect of the fields {Lorentz Operator or Factor} that is created and accounts for all of the known phenomena associated with the behavior of the magnetic fields. Whether the electrons themselves spin about their central N-S axis is immaterial. See NOTE [8]

11: ABSOLUTENESS

This will be untangling the entire study of magnetism from its inception as to reality. This is therefore written in the correct terminology and not the reversed current relative to the Earth's poles one.

The electron has two poles that will be designated A and B. An electron moving in a conductor points in a specific direction that will be assigned the A designation making the B designation trailing or pointing in the opposite direction.

From Oersted's experiment, but here will be used a straight wire pointing up with the input at its lower end and looking down on same, another magnet placed parallel to said conductor will have one of its poles deflected away from the conductor. As this second magnet is rotated around the conductor, the tip of the pole pointing away will describe a cone whose apex is some point on the conductor half way between the A and B of the second magnet, i.e., a plane at right angles cutting the conductor at said point, with the opposite end describing another cone of identical parameters. Since the leading electron's pole is A, then the magnet's pole pointing away must be B and the other end the A. The deflection of the second magnet is therefore absolute and not relative anywhere in the Universe.

The minimum non-straight conductor is a ring. Again the electron can only flow in one direction with the A end pointing away from the source. The field created inside this ring moves into space from the point center of the ring as one line (keep this simple) in two opposite directions. The A field must go one way and the B field the other. The electron's field effect going in the ring is a plane at right angles to its path. A single electron moving will not create this field line exiting at right angles to the ring. Again to keep this simple, consider two electrons on opposite sides of the ring. Each creates the right angle field that then meets at the point center, but the direction of the fields are alike or repel one another. This forces the circular field to flatten out into a single straight line field exiting from the point center in the two directions that has only *one dimension*, length.

This requires a human observation but only for explanation. Looking down on the ring the flow in the A direction is clockwise and the exiting field is B. Looking at the opposite side down, the exiting field is A. These are then absolute anywhere in the Universe.

To convert these into the current Earth based reference, the A flow is what is called N or the north seeking that is actually the opposite. Likewise the B flow is what is called S or the south seeking that is exactly the opposite.

Simply two such rings carrying a current when in free space and parallel to one another (on the same axis through their centers) when facing and their electron's move in the opposite directions will repel one another; that is two possibilities. When the electrons move in the same direction, they are attracted; that is two possibilities. This is opposite to two parallel wires that repel when the current moves in the same direction. See NOTE [9]

Therefore an intelligent being could determine the electron flow in said rings and their respective actions and the field's effect directions using two such. All of these are not relative but absolute. The readers may contemplate on what would be the results if the planet they or other intelligent beings lived on did not have magnetic poles.

12: PROPOSED EXPERIMENTS

There is one missing experiment that the author believes has never been done. Does the current in a straight conductor create N and S poles at its ends?

The apparatus will be tube of conducting ferromagnetic material

1. A battery with its stiff wire connections will be affixed at its middle and totally insulated. The ends of said wires will go to two disks with the appropriate shape (spring type brass or what ever, so that when it is inserted in the tube, the end disks make contact with the inside wall of said pipe at or near its ends.

Then it is placed in an insulated boat (styrofoam will do nicely) and floated upon a water surface (plastic pan will do here also) or suspended at its middle balance point from a long string.

If this straight conductor has a created N and S fields, it will then rotate some part pointing to the N and S poles of the Earth. If it does not, then Oersted's original experiment showed that the upper and lower (relative) fields cancel one another and the apparatus will not move in any direction due to the current flow.

This then means that the movement of said compass needle is a localized effect at that particular relative point whether or not the wire is horizontal or vertical or points in between in any direction, i.e., like along **any radius** inside a sphere with its center as one point in the conductor surrounding that point, as the needle is pointing in three-dimensional space.

Following is the drawing the author used for many purposes. One was to verify the following.

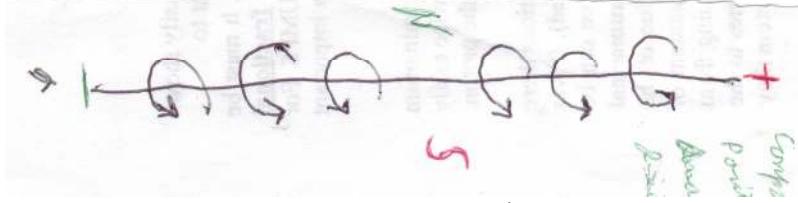


Figure 4

The other experiment is to take a straight wire and then bend it gradually into the loop. [Figure 4 was used for this purpose.] There should be no N and S poles until after the midpoint is reached or the loop's angle has reached 180 arc degrees, i.e., a hairpin shape. In spite of what most textbooks show, look at the illustration for one loop (was a ring) that has iron particles showing the field lines per Figure 3 (b). Notice that only those that essentially run parallel inside the ring or solenoid create the apparent N and S poles. That is, this *apparent acting* as a bar magnet with parallel line fields is inside the coils and has **no pole holes** and does not extend parallel fields (diverge and spread into space per the inverse square law) outside the coil (includes a solenoid) itself that still have the circular fields surrounding them per Figures 1 and 3 (b). There is **only one single field line** having only *one dimension of length* that extends out of the ends that goes absolutely straight forward into space. This **single line is a hermaphrodite** as it has no finite source of direction. That is, it starts from just one point inside at the exact {mathematical point!} center of the coil (for the solenoid at its mid-center point) and half goes left and half goes right, i.e., a red arrowhead and a green arrowhead. When an exterior red arrowhead meets the red arrowhead, the fields bend apart (repulsion) and for meeting a green arrowhead attraction and vice versa. There is still another field that surrounds laterally all the turns of the coil like the cross-section of a capsule. Figure 1 shows these three distinctive fields surrounding a solenoid. The author is willing to bet that these demonstrations were not done in a magnetically shielded or at least neutralized (degaussed) Earth's magnetic field. Therefore, they are slightly distorted due to the effect of the Earth's magnetic field.

However, using foreign materials that themselves have magnetic fields (iron dust or what ever) **upsets** the results and so whether or not one is actually seeing these field lines or the *apparent* field lines, is a matter of opinion. This cannot be discussed here as it requires permanent magnets that are in another paper.

The author used and can only suggests that in all future illustrations etc. that N pole and field (line and arrowhead) is green and S is red likewise. This will also leave marking a car battery's positive terminal red or with a red wire and electronic circuits to comply with tradition etc. per Figure 4.

On Sunday 10-22-06 at 7:30 PM the question came to the author's mind of what would happen if a short solenoid was stretched out while reducing its diameter and when would the field inside disappear? The answer was then determined at 4:30 PM on 10-23-06.

For a single turn, it would be in reality six atoms in a hexagon shape or one at each apex with one then removed or an irregular pentagon. The input would go to one and the output to that fifth one. Therefore, for a solenoid of multiple turns would be those 5 repeating. Then when it was then stretched out it would be identical to a straight conductor and the N and S fields would disappear.

13: CONCLUSIONS

There will be no specific conclusions so listed. The true results are obvious and the falsities now being promulgated likewise. The second of the greatest importance, Oersted is first, is that Ampère had it correct with the cathode and his right hand rule.

There is one comment. The current physics textbooks are an abomination and it is a wonder the students learn anything and if they do it is mostly wrong.

There does remain what are the effect of currents of free charged particles that will have to be in another paper. In these cases **ALL** of the fields are effective.

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NOTES:

[1] My son Paul T. Schreiber used reference 6. when attending college and received an EE Degree. He later received a Masters Degree in EE. It was from his studies and his later employment that he told me of the problems in physics and EE studies. The other comments herein are to the best of his knowledge or what he remembered. Hence, the qualifications so noted in the main text. Reference 8. is 6. that had another author and the name changed. However, it bears little resemblance to the original what so ever.

[2] In the August 2006 issue of *electric space craft* was an article by Ionel Dinu of Bucharest, Romania, titled *What's behind Faraday's Magnetic Lines of Force*. From reading this paper the author noticed that in the many illustrations and the end effects of the magnetic fields of straight wire(s) and solenoids (helixes) something was missing.

None of the illustrations showed the input connection (current) and the resulting N and S magnetic poles. So the author went back to his textbooks and started researching this matter. The end result is this paper.

[3] In reference 6. on page 566 are two figures. The top FIGURE 30-11 (Figure 1) is a short solenoid with the magnetic field lines but no input. In FIGURE. 30-12 (Figure 2 (a)) there are the field lines and the input current (i) entering from the left and the S pole to the left and the N pole to the right. I had some suspicion that this was not correct and had to do much more research before the truth came out. 8. *left out* (deleted) the current and poles that were shown in Figure 2 (a).

As per the opening statement on the flow of current, if this figure's input was negative it is correct. IF it is per the current falsity or positive input, it is false. I rest my case.

[4] Brevity prohibits what should go here, so only the barest information is given. The words cathode and anode have almost disappeared from textbooks! Likewise what was named the cathode gave rise to X-rays. With the advent of being to create a high vacuum inside a closed glass tube and a source of high voltage there then was the ability to observe the actions of the gas (air) in the tube with an electrode sealed into each end as it was evacuated. From Reference 1. pages 521-525 gives the full discussion.

Skipping over the effects as the air is evacuated, an overall glow is replaced, then with striations (disks) and dark spaces between. Then there are dark spaces, the first of which is between the cathode and the first striations called the Faraday dark space. At still lower pressure, the dark space starts away form the cathode and finally fills the tube. This dark space is called the Crookes dark space. Finally the glass at the anode side starts to glow, normally green due to impurities in the glass at that time. Therefore something was coming off the cathode and were named cathode rays. By inserting a solid metal shape between the cathode and anode (the Maltese Cross was a favorite) the glowing glass had the shadow of the cross. Then it was discovered that a magnetic field bent these cathode rays so they were not rays (like light) but something else. To speed up.

This cathode ray tube then had inserted in it other electrodes that Braum invented that was then and now is used in oscilloscopes. This particular tube is called a cathode ray tube (CRT) and a variation of it was used by Thomson to discover the electron. It is this tube that TV's used and what is now called the monitor for PC screens.

Now going back after 1. in chronological order, from the references:

Generic: From batteries, there was used for a while that as for the common zinc-carbon dry cell, that the zinc casing was negative and was called the cathode and the carbon rod the anode. This fell out of favor over 50 years ago.

(1) pages 521-526: Shows the apparatus as Fig. 463 on page 521. Discussion follows in order to discovery of X-rays by Roentgen. No mention of anode. No oscilloscope or CRT as such.

(2) page 141: Faraday's contribution and why the anode and cathode were defined (named). Details of the oscilloscope and its cathode rays are electrons. Thomson etc. Mentions low pressure discharges like the neon sign tube.

(3) Nothing on any of the subjects.

(4) Has anode and cathode page 168. Page 201 has X-ray tube using cathode and anode. Pages 266-267 has Crookes and Faraday dark space, but no great details overall. Page 232 has oscilloscope.

(5) No anode or cathode. Thomson and electron ignored. Nothing on cathode rays etc.

(6) Nothing. Has Thompson experiment but not named as cathode ray etc.

(7) Page 587 has Thompson experiment. Words cathode and anode used (not in index).

(8) Ditto as for (6)

(9) Page 488. First to have CRT and uses cathode and anode (not indexed) in description.

Therefore, for all practical purposes, the words cathode and anode have essentially disappeared from textbooks. Likewise the very important experiment(s) of evacuating the gas from a tube with an electrode at its ends that gave rise to the discovery of the electron, X-rays and in modern times TV. See NOTE [10].

But this is not all. The author uses the Random House Webster's College Dictionary and in this dictionary for the word cathode is: n. 1. the electrode or terminal by which current leaves an electrolytic cell , voltaic cell or battery. 2. the positive terminal of a voltaic cell or battery. 3. the negative terminal, electrode, or element of an electron tube or electrolytic cell. Sheesh. 1. should be combined with 3 and 2. is false, so needs deletion. The word anode is opposite and has its 2. false.

Suggestion: cathode, n. source (negative terminal) of electrons that flow out into a medium or space called current.

anode, n. receptor (termination or positive terminal)) of the flow of electron current
[coined M. Faraday circa 1833] for both

[5] Edison in 1883 discovered that his carbon filament became a cathode when he had another electrode some length away that was then the anode. This was the thermionic effect and named the Edison Effect. It was the first vacuum diode tube. Thomson used a carbon filament cathode (electron source) in his CRT as a result of this discovery. Both of these have long been removed from current books of any nature. Edison's discovery was renamed after another who studied it, déjà vu.

[6] Elements or their compounds can go from good conductors to very little conduction, if any, that are called insulators. In between conductors and insulators are semi-conductors or a no-man's-land. Therefore the word normal means for those that have a reasonable conduction. Obviously somewhere there will be no detectable magnetic fields after the semi-conductors are passed and become insulators. Likewise alternating currents require their own currents and magnetic fields that still obey the fundamental creation of the magnetic fields.

[7] This is NOT the Relativistic compression. **The propagation speed of an electric field or a magnetic field has never been measured.** There is no theory that can even predict their propagation speeds. It can be reasonably assumed that their propagation effect speed is at the speed of light from secondary experiments. Hence, the fields would be compressed tightly into a plane at right angles to the electron's path and the trailing fields would go to near zero effect. This is similar to the Doppler Effect, but there are no changes in the fields parameters and properties. Simply, it could act like a thin disk so that it can be drawn as a ring or a circle around the conductor.

At the sake of overkill, consider a gun firing a projectile forward at the speed of light that does not have its speed increased (as light acts) so that it would never leave the source ahead, but could at other angles. And, this projectile fired to the rear would simply disappear for all practical purposes.

[8] My son informed me that he thought that this north pointing electron might have been in one of his textbooks on fields, but he did not actually remember it, so someone else will have to supply this information if it does exist somewhere.

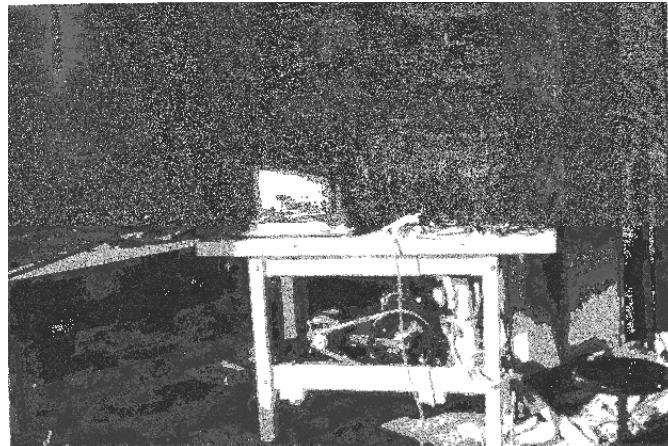
[9] For brevity I did not give a real equivalent example. Use two of those disk magnets with our without the hole in the center, one with a hole best. Mark the S faces on same. Holding the disk vertical with the S facing left, draw an arrow with the head facing down on the front edge. Repeat with the second.

This is then the identical effect to a single ring with the current flowing in the direction of the arrow.

It is easily seen that when the S faces S or N faces N, the magnets are repelled and the directions of the arrows are opposite in direction. When the N faces the S, they are attracted and the arrows are in the same direction.

Again, which frame of reference is being used, in this case the flow of the electrons, changes the end results

[10]



This is a photo of the experiment. It was done at Southwestern Louisiana Institute in Lafayette, LA during 1946-1947 of my senior year there. I was the laboratory assistant for Dr. Paul Delaup head of the physics department. Under the top on the bottom shelf on the left is a Welsh rotary vacuum pump and a mercury high vacuum pump to its right. The large box on the top left is a Rumkoff coil (spark coil) that was part of a 1900's X-ray machine as the power supply. The tube with its end electrodes is mounted on the cross bar is evacuated from a glass tube affixed at its center down to the mercury pump inlet. At the center with the cord hanging down is a hand held Tesla coil that was used to check for leaks in the system as a spark discharge would go from it to inside the system showing any leaks. If no leaks, the sparks simply spread over the outside of the system. Not shown is a system using mercury to measure the vacuum achieved. It was built by Dr. Delaup as he was an excellent glass blower. Basically, the system was connected to a glass globe with a long small hole glass tube sealed at the top attached vertically. A mercury supply was then raised upwards and the mercury sealed off the inlet hole and compressed the gas in the globe and then up the tube so that when all the gas was at the top the degree of vacuum could be measured. When this system was working, in about 2 hours X-rays were produced causing the anode end of the glass tube to glow green. These were soft X-rays and not extremely harmful anyway for short exposure times. Note that this is of importance, but the X-ray tube from that machine is now (or was the last time I went there) on display in a glass case at the physics department. On the left of the photo is the glass working bench with the torches (oxygen and acetylene) to left, center, and right of the bright dot. On the floor in a long rectangular box are the glass rods of various diameters and materials, i.e., soda glass, Pyrex etc.

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October 2006