2.2

An Atmospheric Electrical Hypothesis for Spherical Luminosities Occurring at Aircraft Altitudes

Richard E. Spalding[1]
NARCAP Research Associate

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Introduction and Background

The intent of this section is to put forth the premise that luminous spheres appearing at aircraft operating altitudes are most probably an atmospheric electrical phenomenon. Arguments to support this premise are presented, as well as a hypothetical model for the necessary energy transfer mechanism thought to be at work. The envisioned energy transfer mechanism is not, at this time, recognized to exist by atmospheric scientists. Consequently it is necessary to build a strong evidentiary case for its existence. The intent of the material included here, particularly that regarding other phenomena considered to be related, is to do just that.

In addition to luminous spheres at aircraft altitudes, there exist a variety of other unexplained atmospheric phenomena whose origin is undoubtedly electrical. Prominent among these are ball lightning, earthquake lights, and swamp lights. That these phenomena remain enigmatic despite persistent efforts by atmospheric scientists to find explanations implies some sort of deficiency in their science. It is contended here that the logical reason explanations are unable to be found is that scientists' knowledge of how electric charge can move about the atmosphere is incomplete, and that the key to understanding these phenomena lies in discovering at least one new charge/energy transport mechanism, such as the one hypothesized herein.

The ideas presented in the following paragraphs are unavoidably highly controversial. They deal with phenomena considered to be on the fringes of science, and moreover, they challenge the determinations of that science regarding atmospheric electrical behavior. Consequently, it seems necessary at the beginning of this treatise to spell out how these ideas have arisen. The objective is to provide readers enough information to permit them to judge for themselves whether such controversial ideas may have validity or not.

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[1] The author is an experienced Electrical Engineer (MSEE, Purdue, 1962), who has been employed at a national laboratory for more than 47 years. Nearly all of his career has involved design of earth-monitoring space-borne instruments and analysis of data derived from them.

The focus that has resulted from the author's professional work is an ever-increasing interest in transient events occurring in Earth's atmosphere and in the ionosphere/magnetosphere above. Included in that interest are a diversity of geophysical events such as lightning, meteors, earthquakes, volcanoes, tornadoes, unexplained explosions, terrestrial gamma flashes (TGFs), and the gamut of luminous flashes recently discovered to be occurring above thunderstorms (Red Sprites, Blue Jets, etc.). Quite naturally, unexplained aerial phenomena (UAP) are also included in that interest.

Having such a broad range of interest has permitted the author to see a recurring theme of inexplicability regarding several transient events within the atmosphere. Whether the subject is lightning, meteors, earthquakes, or whatever, there invariably seem to be important aspects of the events that scientists studying them are unable to explain. This leads to the conclusion that there must be something very basic missing in their understanding of the processes involved, i.e., in their physical models for atmospheric electrical behavior. Conviction in the idea that something in their science is missing has driven the author to range far afield in trying to uncover what that something may be. The results of such thinking are laid out in the pages that follow.

Need for an Atmospheric Conduction Mechanism

In sizing up the wide variety of phenomena not explainable by atmospheric scientists, the following idea was concluded. If there existed a mechanism by which electrical charge and energy could be invisibly conducted through the atmosphere, then such a mechanism could play a major role toward providing explanation for a large fraction of the extant enigmas, luminous and otherwise.

In today's paradigm for atmospheric electricity, the only recognized means for delivering charge and energy from a remote source to a specific point is via electrical breakdown, a noisy and far-from-invisible process. Other charge/energy transfer mechanisms, such as convection and diffusion, are not compatible with delivering to a small isolated target. Consequently, the author came to be on constant alert for any published indication that such a conduction mechanism may have been observed.

Air Threads

Search of peer-reviewed literature relating to lightning or to ball lightning experimentation did not uncover any observations of phenomena resembling invisible conduction through air. However, almost by chance, on the Internet, a description was found of an experiment showing electrical behavior that seemed to be exactly what was being sought. It happened that in June of 1998, Bill Beaty of Seattle, Washington, experimenting at a "Seattle Weird Science" meeting, observed some very strange and unexpected electrostatic effects. Descriptions of his observations (1.) can still be found at: http://www.eskimo.com/~billb/weird/unusual/airthred.html

The following is an attempt to briefly summarize his experimental apparatus, his observations, and to suggest how these observations likely relate to the subject of the present Project Sphere.

Beaty's Apparatus

Demonstrating the phenomenon of what Beaty termed "air threads" was accomplished with a very simple setup. It consisted of a high voltage (HV) DC supply (about 10 KV) with appropriate clip-leads, a shallow aluminum pan (cookie sheet) with about a centimeter of warm water in it, and a small amount of dry ice, crushed into chips and sprinkled onto the water surface. The dry ice, in contacting the water, produced a thin, but uniform layer of mist upon the water. The purpose of the mist was to create a surface that would allow even very weak interactions to be observed.

The Observations

With one lead of the HV supply connected to the pan and the other to a clip grasping a metal needle held several inches above the pan, he noted that a large hole would be blown in the mist when pointing the needle tip at it. This he attributed to an "ion wind", with the needle tip being the point where air molecules were being ionized, and the HV-produced electric field accelerating the ions downward. This effect was not particularly surprising.

However, when a non-metallic fiber such as a hair or bristle was held in the clip, intriguing results began to appear. Then, instead of a large hole, only a tiny hole, or dimple, showed up on the mist layer. In addition, the dimple and the fiber tip appeared to be connected by an invisible thread-like pathway, which Beaty termed an air-thread. More striking, when two or more fibers were held, the mist showed a pattern of dimples that duplicated the pattern of fiber tips above. For example, if a scrap of paper with a torn edge was connected to the HV supply and held torn-edge down, a linear pattern of dimples appeared on the mist, aligned with the paper's torn edge. Rotating the paper about the HV-mist axis caused the line of dimples to rotate accordingly. Presumably, each dimple represented the terminus of a connection beginning at the point of an individual fiber protruding from the torn edge.

Similarly, with other arrangements of fibers, other patterns of dimples could be produced. It appeared that each fiber tip became the launching point for an individual thread. Fiber tips separated by only millimeters produced dimples similarly separated by only millimeters, even when thread length was hundreds of millimeters. While some spread in the dimple pattern occurred as channel length was increased, the effect was quite small in comparison to channel length.

One property of the threads noted by Beaty was insensitivity to magnetic field. Bringing a strong neodymium magnet near to a channel did not cause it to be deflected. The channels also proved insensitive to wind. Blowing at a channel using a soda straw produced little deflection. A third property noted was insensitivity to HV polarity. Threads would form irrespective of whether the HV at the fiber tip was positive or negative, with the resulting threads exhibiting the same characteristics.

A Discussion About Air-Thread Observations

The above "air-thread" observations, while outwardly simplistic and unscientific, nevertheless have important implications concerning possible atmospheric electrical behavior.

It seems impossible for thread characteristics to be explained simply as electrostatic field effects. Electrostatic fields emanating from multiple tips would surely blend together to form a smooth, almost featureless field in the vicinity of the mist. Secondly, it is quite apparent that in the mechanism, charge and energy are being transported between fiber tips and dimples along narrow filamentary channels. How else could an arrangement of numerous, closely-spaced fiber tips produce an identical arrangement of closely-spaced dimples on the mist?

Mere existence of the air-thread mechanism is of great importance here. An invisible, conductive channel through air is precisely the kind of mechanism that is needed to explain phenomena like ball lightning and luminous spheres that trail aircraft in flight. Invisible, conducting channels could supply the energy necessary to sustain their luminosity.

It is commonly held that motions of ions in air are dominated by interaction with air molecules. Incessant collisions with air molecules serve to scatter ions in random directions, even as the ambient electric field tends to pull them in a specific direction. Motion of charge under those conditions is termed “diffusion”, and because the individual charges spend much of the time moving in directions different from the general flow, progress via diffusion is slow and incoherent.

In the air-thread phenomenon, it seems to be the case that the expected collisions with air molecules are for some reason not happening, at least for the bulk of the charges moving within the thread. Charges moving simply by diffusion could not possibly create small dimples in the mist, for even a modest number of collisions en route would deflect them away from their path to the target dimple.

In attempting to visualize how the threads are forming and why they behave as they do, the author has pieced together the following collection of ideas. The resulting “model” may not be the correct one for this mechanism, but it does seem to provide explanation for most of the properties being observed. Mostly, the model is being offered as an example of how conductive channels in air might exist, but without insistence that they occur precisely this way.

First, ionization is surely taking place at the fiber tip, with its sharp point serving to concentrate the electric field to an ionizing level. Ions produced there may be derived of material from the fiber, the surrounding air, or possibly from the mist/water layer below. In addition to creating ions, the electric field imparts a velocity to those ions in the direction of the field, i.e., toward the mist. That velocity is envisioned to be enough greater than that of air molecules such that when collisions do occur, the greater momentum of the ions keeps them generally on course, with the air molecules experiencing the larger angular deflection.

A stream of ions flowing from the tip as described above can thus affect the motions of air molecules adjacent to the thread. Air molecules that wander into the path of the ion flow are deflected away from that flow. Further, deflected-away molecules, when they collide with other air molecules, impart velocity vectors to those molecules that is generally away from the channel. Thus the action of repeated deflections of air molecules away from the path can create a pathway that is essentially cleared of air molecules. An analogy might be the flow of water from a fire hose, wherein the momentum of the water clears a path through the air. Clearly, there is interaction at the periphery of the stream, but the bulk of the water molecules in the stream move forward without undergoing collisions with the surrounding air.

So, it is envisioned that the flow of ions streaming from the fiber tip, uniformly moving in a direction dictated by the electric field, serve to clear their own pathway. Because, in a sense, the bulk of surrounding air molecules are being kept at bay, the ion flow encounters relatively little energy loss along the pathway, and thus the path itself can remain invisible.

For the channel to remain filamentary requires that it not be composed of only one polarity of charge. Otherwise mutual repulsion of like-polarity charges would cause the channel diameter to expand. Within the channel, there must be balance of negative and positive charges, so that mutual attraction of unlike charges can offset the repulsion between like charges.

One potential model for the filament structure could be imagined as a stream of positive ions surrounded by a sheath of electrons. With equal numbers of positive and negative charges, the filament would be electrically neutral. In the structure, the ions and their momentum would provide the rigidity needed to define and maintain the filamentary pathway. Electrons would move along the structure in much the same manner as they do along a metallic wire conductor.

One problem with the above model is that the electrons would undoubtedly respond to incident electromagnetic radiation just as they do in a wire, making such a conduit a strong reflector of radio waves (e.g., radar). The nearly ubiquitous absence of radar reflections in reports of atmospheric luminosities would seem to rule out this model being the correct one.[2]

The model preferred by this author is one in which both the positive and negative charges are ions. Because ions necessarily have thousands of times more mass than electrons, they can only weakly respond to incident electromagnetic radiation, a response necessary to produce the oscillating electrical current that creates an opposing radiation (i.e., reflection). Thus, an all-ion conduction channel would be an ideal candidate for being able to supply energy to luminous spheres and other elevated phenomena without producing radar reflections. Conversely, a channel in which electrons were the principal charge carrier would be a strong reflector of radar waves. For the visible masses to also produce little or no radar reflection, the active elements of those masses are also likely to be constituted of ions.

It should be noted that, under the influence of an electric field, positive and negative ions would be moving in opposite directions within the channel. This idea, that ions of opposing polarities could exist in very close proximity without recombining, will undoubtedly be anathema to electrophysicists. Nevertheless, the observed characteristics of air threads strongly imply that to be the case.

A further thought concerning the makeup of such a channel is that it requires injection or creation of ions at each end. One novel possibility is that in the vicinity of the fiber tip, air molecules are ionized to the tip polarity, then travel toward the terminus (mist or water), where upon arrival they are converted to ions of the opposite polarity, which then causes them to travel back toward the tip to become re-ionized again, and so on. Such action could explain

[2] There are reported instances of luminous UAP detected simultaneously by human vision and radar. (Ed.)

why the thread is electrically neutral (has equal numbers of positive and negative charges). If, for example, positive ions were lighter than negative ones, they would be accelerated to higher velocity, and would thus transit the length of the thread more quickly. This would result in fewer positive ions in transit within the channel, and (at any instant in time) the channel itself would have a net negative charge. Again, mutual repulsion between excess negative charges would then cause the filamentary character of the channel to be destroyed. On the other hand, if the molecules being ionized at each end are of the same species, then transit times would be identical, and with new ions being created on a one-for-one basis, the channel itself would remain neutral.

Another point of interest about an established air thread is that it could be "stretched", that is, lengthened up to some amount by moving the tip further from the mist. Through this observation, the author draws the conclusion that the prime necessity for the high voltage is to create ions at the tip or mist, and that the "voltage drop" along the channel, i.e., its resistance, is small. That would in turn imply that if a source of ions already existed at each end, the potential difference necessary to establish a thread could be surprisingly small.

Summarizing the air threads observations, it certainly appears that they strongly indicate the existence of invisible conductive filamentary channels through air. Further, the fact that the threads form naturally, requiring only an electric field and ion sources, implies that they could easily occur in a wide variety of situations in the natural atmosphere.

Some Final Points about the Hypothesized Mechanism

The ease with which threads can be created and sustained makes them quite amenable to precise laboratory measurement and analysis. Investigation into their composition and their characteristics should provide insight concerning the mechanism's possible role in atmospheric electrical activity. In addition, the idea of a filamentary structure composed of ions of both polarities is one that should be relatively easy to test mathematically, i.e., via computer simulation, since the forces of interaction are well known.

Ball Lightning[3]

Events categorized as ball lightning exhibit a variety of sizes and characteristics. Indeed, in his volume "Remarkable Luminous Phenomena" (2.), William R. Corliss has addressed some twenty-one different variations or properties of them. The form most often reported, which he calls "ordinary ball lightning", is typically a small, spherical, luminous blob of air or plasma that enters a room through a chimney or window (sometimes a closed or screened window) and meanders about almost aimlessly before disappearing, with disappearance often attended by a loud firecracker-like report.

For years, many scientists doubted that ball lightning represented a real, physical event. Some tried to attribute it to optical illusion or after-image effects. Today, existence of the phenomenon seems to be generally recognized, and in recent decades a number of scientists have attempted to create ball lightning in the laboratory. So far none of those attempts have

[3] Also see paper 4.3 (Ed.)

succeeded in producing results that exhibit the salient characteristics of the phenomenon in any satisfying way.

One of the premier questions scientists have tried to address is where the energy to sustain the ball's luminosity comes from. Some have suggested chemical energy stored within the ball as an answer, but this would seem incapable of explaining extended duration events. Others have proposed electromagnetic energy radiated microwave fashion to the site of the ball. However, generating or focusing mechanisms that would be needed to support that contention have not been envisioned and seem highly unlikely to exist in nature. One idea currently being pursued is that the ball is a mini-black hole. This idea seems particularly attractive for explaining events wherein a huge amount of energy is implied, as in one case wherein a large trench was excavated under the path of a large ball as it moved along the ground.

To this author, the existence of ball lightning begs for (the) existence of an invisible electrical conduction mechanism through air. That would explain how the ball is supplied with energy. In the air threads discussion above, such conductions appear to be producible on a modest scale in the laboratory. Whether nature does something similar, but on a larger scale, remains to be discovered.

If conduction of energy to the lightning ball were (was?) being accomplished via the air thread mechanism, it would tend to provide answers for some other nagging questions about ball lightning behavior. One question is why the ball, if electrical, is not attracted to metal structures but instead wanders about, tending to "ignore" them. If the thread were indeed composed solely of ions, then it would find no advantage in connecting to metals, since the ions could not move through the metal matrix. And, if electrically neutral as hypothesized, the thread itself would not be drawn toward any nearby electrically charged objects.

Another frequently observed feature of ball lightning, the loud bang at its disappearance, might also fit into the air thread concept. If the conduction pathway is maintained by holding surrounding air molecules at bay, then when the structure collapses, air molecules will rush into the void, creating an implosive shock. It seems likely that the ball also will create at least a partial void upon its disappearance, adding to the implosive shock.

In the historical literature, it seemed that ball lightning had a propensity to appear in places like farmhouse kitchens where the air quality was undoubtedly low. The idea that a conduction channel can exist when a supply of ions is available at each end might explain this propensity. The presence of unburned gases in the kitchen or open fireplace could amount to an easily ionizable source. A modern day account of a lightning ball moving down the aisle of an airliner might also be partially explained by the relatively low air quality existing there.

Meteor Enigmas

For many decades, the bulk of meteor scientists considered the meteor phenomenon to be rather well understood, with production of light and sound quite explainable by hydrodynamic models of the hypersonic penetration of Earth's atmosphere. However, there were occasionally reports of observations that the models could not explain. Notable among these were occurrences in which persons on the ground heard buzzing or rustling sounds while the meteor was still in luminous flight. Normally, sound generated by the meteor would have taken minutes to reach the observers, so coincident sound was highly unexpected. And, as is so often the case when untrained observers report things that don't fit the prevailing models, the reports themselves were considered to be suspect.

In 1980, however, after following up on numerous reports of sounds being heard simultaneously with the April 1978 New South Wales fireball, Australian researcher ~~Colin~~ Keay (3.) became convinced of their reality, and proposed a theory of their origin. He surmised that in the meteor's long, turbulent trail, electrical currents were induced that radiated strongly in the VLF radio spectrum, and that in turn, the strong VLF fields in the vicinity of the observer induced vibrations in lightweight materials such as leaves and hairs to produce the sounds. This certainly amounted to a plausible explanation. However, although some VLF signals have since been observed to be associated with nearby meteors, exceptionally strong ones, the kind necessary to rustle leaves, hair, or fabric have not so far been measured. Nevertheless, meteor scientists have picked up on Keay's theory and embraced it, with the result that significant further investigation of "electrophonic sound", as the phenomenon is now called, has not yet occurred.

What this author proposes to be the more likely electrophonic sound generation mechanism is the following. The meteoroid, necessarily having penetrated the ionosphere prior to descending into the neutral atmosphere, creates a conductive trail that serves to maintain a connection between the ionosphere and the meteoroid. This, in effect, places the meteoroid at ionospheric potential, or nearly so. Bringing a spear of ionospheric potential down to the penetration depth of a large meteoroid produces a substantial perturbation on the ambient electric field at ground level in the vicinity. This disturbance can in turn apply an electrostatic force to charges embedded in non-conducting materials, in the same manner that a charged comb can pick up a scrap of paper. Even ions in the ambient air would be subject to the change in force, and would transfer perturbation energy to the air.

If the disturbance were a single, smooth transition, it is unlikely that a noticeable sound would result. However, in a recent paper, Spurny and Ceplecha (4) report a discovery that millisecond flares are a nearly ubiquitous property of meteors. They note that these light increases are too rapid and too brief to be explained by hydrodynamic processes, and propose that they are likely of electrical origin. Assuming that change in light emission is also associated with state of electrical charge of the meteoroid, then there would be an electric field perturbation at ground level associated with each flare. Interestingly, the rate of flaring on some meteors was just right for producing what might be called a buzzing or rustling sound.

Although the trail immediately behind a meteor is luminous, that luminosity does not extend all the way back to the ionosphere. So the question arises as to whether an invisible conductive path between meteoroid and ionosphere is a typical part of the meteor process. If so, such a conduit could help explain both the flaring and the anomalous sounds at ground level.

Ionosphere-to-Ground Leakage Paths

Since there is substantial electrical potential difference between ionosphere and earth surface[4], it is quite conceivable that "leakage paths" between the two somehow form. And, having seen the air threads mechanism, it would seem plausible that at least some of the leakage paths could take on that form.

If, as also conjectured, the strength of a thread connection is dictated by availability of ions, then it seems likely that the earth terminus is responsible for limiting the ionosphere-ground connection to that of a "leakage". Charges in the ionosphere are both copious and mobile. However, ions at ground level are not normally available in quantity, and the ambient electric field is too weak to support ionization of air molecules or other materials. So, any connections that do exist must result from other ion-producing processes, such as cosmic rays and slow oxidation. Quite naturally, paths supported by these would be highly charge-limited, amounting to very weak connections. Although it is not necessary that such connections exist in quantity at ground level, much of the behavior of phenomena addressed in the succeeding paragraphs would seem more plausible if that were true.

Swamp Lights

Let us consider how the model of invisible conduction channels could fit into a description of what is probably occurring in the swamp-light phenomenon. Routine ionosphere-to-swamp channels are presumed to pre-exist, but without an ample source of ions at the swamp surface, remain too weak to be visible. However, when a bubble of gas escapes from the bottom mud, rises to the surface, pops out as a concentrated plume of ionizable material (e.g., methane), which quickly mixes with the air, the ingredients then exist for a weak channel to quickly strengthen. With descending ions providing much of the energy needed to increase the rate of ionization, the gas-air mixture and the ionizations occurring within it can now become luminous. It may also be true that more than simply ionizing swamp gas molecules, descending ions, can set the stage (i.e., elevate their energy states) for some of those molecules to combine with oxygen in the air, with a further release of energy (oxidation) to aid in (the) production of light.

Note here that it is the energy delivered by a descending ion that permits this conjectured molecule-scale combustion to take place. Without it, oxidation (combustion) of gas molecules would either not occur or would do so at such a low rate that not enough light would be produced to be perceptible. And, although ion-aided oxidation of the gas molecules may proceed at a sufficient rate to become a luminous volume, its energy concentration is still far less than is needed to heat the gases to a temperature that can produce self-sustained combustion.

In the above, it was the presumption of electrical energy conducted to the swamp-gas/air mixture that helped support the generation of light. Failure of previous experiments to recreate the swamp light phenomenon in the laboratory is undoubtedly due to not having understood the need for that ingredient.

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[4] Measurements have shown a potential difference as high as 400,000 volts with a gradient on the order of 200 to 300 volts per meter altitude near the earth's surface (Gringell, et al., 1986)

Earthquake Lights

Similarly to ball lightning, study of the earthquake light (EQL) phenomenon has been generally shunned by earth scientists. Evidently, because the phenomenon in its many forms does not fit into the prevailing paradigm for earthquake cause and effect, it has been easier for modern-day scientists to ignore it rather than to try to study it. Indeed, if canvassed, most of them would probably indicate doubt that the EQL phenomenon is real. It is easy to label luminous events occurring prior to or simultaneous with major quakes as mere coincidences. That places them conveniently beyond the need for explanation.

Geophysicists doggedly adhere to the idea that earthquakes are caused by tectonic plate movements, with stress at plate boundaries continuing to build until fracture occurs along a fault line. Despite extensive stress/strain monitoring in earthquake-prone areas, no quake has ever been predicted using stress/strain data with any useful time accuracy.

In recent years, however, a phenomenon has been discovered that does appear to offer a means of prediction. Its discovery had nothing to do with stress/strain monitoring, but instead involved ground surface temperature measurements using satellite infrared imaging sensors. Termed a “thermal anomaly”, the phenomenon comprises an area of unexpectedly elevated ground temperature surrounding the epicenter of a major quake. Significantly, the anomaly often begins days to weeks prior to first shock, thus making possible a comfortable period of time for alerting the populace and allowing pre-quake preparations to be made.

Unfortunately for persons living in earthquake-prone areas worldwide, however, this information is being interpreted as manifesting from stress-induced piezoelectricity in subterranean rock layers, which somehow then create the electrified species in the air above that serve to fool the satellite sensors into seeing a temperature increase. Thus, rather than promoting practical systems of ground-based temperature monitors in earthquake-prone regions, the geophysics community’s attention has instead been turned toward trying to understand the hypothesized piezoelectric mechanism and how it might be exploited.

It is extremely unlikely the premise that piezoelectric effects deep underground can somehow create an illusion of increased ground temperature to satellite sensors will be found to be true. A much more likely explanation for the thermal anomaly can be found in Gold’s book “Power From The Earth” (5), in which he contends that gas emissions from below are not only responsible for the earthquake itself, but also for most other mysterious precursor observations historically connected with great earthquakes. These include changes in ground water level and contamination of well water, sulfurous odors, unusual behavior of animals, especially burrowing ones, and fish kills. Even “earthquake weather”, a condition of unusually warm and oppressive air noted prior to a quake, can be explained as due to the gas emissions.

What becomes apparent from digesting these clues is that thermal anomalies arise not from piezoelectric effects, but from the heat carried upward by gases from below. Therefore, the best way to detect an imminent earthquake would be to monitor for the presence of those gases. This could be accomplished by monitoring for specific gases, such as methane or carbon monoxide/dioxide. But, a more practical method would be to simply monitor for temperature deviations at ground level, or better yet, also a few feet under the surface, where diurnal variations are minimized. There, small changes in temperature due to the gases would stand out compared to those induced by weather above.

Let us return to the luminosities. At the same time that release of subterranean gases causes the effects mentioned, it also modifies the local lower atmosphere, adding to it concentrations of oxidizable molecules. These change its electrical properties, particularly the conditions under which ionization can occur. The contaminants are important in that they become sources of ions to support formation of or growth of thread-like channels of electrical conduction. So, whereas the ionosphere, in connecting to ground, is generally limited in the strength of its connections by availability of ions at ground level, release of earth-gases suddenly changes the picture. Stronger connections can then form, and these can in turn support luminosities of the kind described by eyewitnesses in earthquake locales.

Regarding EQL, ~~F.~~ St-Laurent (6.) provides a comprehensive summary of luminosity observations associated with the Saguenay, Quebec quakes of November 1988 through January 1989. Forty-six separate occurrences were recorded during that period. Each of these was classified into one of the following five luminosity types.

1. "Seismic lightning", similar to ordinary lightning and to "sheet" or "heat" lightning, but without the thunder.
2. Luminous bands in the atmosphere, sometimes horizontal or vertical, sometimes in a bundle, like some polar aurorae.
3. Globular incandescent masses, sometimes attached to luminous bands, and sometimes called "meteors".
4. Fire tongues, small "flames" creeping near the ground, or, like ignis fatuus, flickering around.
5. Seismic "flames", seen emerging from the ground but very rarely causing any damage.

Of significant interest here, 22 of the 46 (48%) Saguenay observations were of category 3. These "globular incandescent masses" were either spherical or ovoid in shape, were seen to pop up out of the ground, or to fall downward like meteors, or to remain stationary or move slowly through the air. How any process associated with the earthquake phenomenon can result in glowing masses of this form that move about in the air is indeed a puzzle.

However, suppose that each of the glowing shapes represents a "node" in an invisible filamentary channel between ionosphere and ground. By node is meant a point along the channel where local conditions force ionization to occur, or conversely, where ions within the channel decay or recombine. The glows and their behavior might then be easier to comprehend. Further, because such a channel would do what electrical connections always do, i.e., find a path of least resistance, or perhaps, of greatest accommodation, then glow movement could simply represent the result of that action.

As noted above, thermal anomalies, surely due to gas emissions, generally onset days to weeks prior to large quakes. In the Saguenay earthquake sequence, the first EQL were observed

23 days prior to the first foreshock. They consisted of three globular masses that popped out of the ground. Over the next three weeks, seven more occurrences of spherical or ovoid luminosities were reported.

Spherical Luminosities and Airplane Flight

To sum up the possible significance of EQL with regard to luminous spheres at aircraft altitudes, the following comparison is noted. In both cases, the local atmosphere is being contaminated by the intrusion of oxidizable or partially-ionized gases. In one case the gases are from the earth. In the other they constitute exhaust gases from the aircraft engines.

Necessarily, the contention that there may be a correspondence between EQL and spherical luminosities trailing aircraft resides on whether the presumed ionosphere-to-ground conduction channels can pre-exist, or alternatively, be quickly formed when a sufficient quantity of ionizable species becomes available.[5] Discovery of that mechanism, or something equivalent, would do much to complete the picture of atmospheric electrical behavior.

Summary

In the preceding pages, the author has attempted to convey the following ideas to a sufficient degree to permit their credibility to be judged and further research carried out.

1. There exists an undiscovered natural mechanism for conduction of electric charge and energy through Earth's atmosphere.
2. That mechanism is likely at work in many atmospheric enigmas, including ball lightning, earthquake lights, swamp lights, and luminous spheres and other shapes seen at ground level and at aircraft altitudes.
3. An easily created lab phenomenon (i.e., air thread) is likely very similar to the conduction mechanism naturally occurring in the atmosphere. Scientific study of the air thread phenomenon should be undertaken.
4. Although many events involving luminosities are benign, some carry the possibility of very large energy depositions, and therefore constitute threats to safety.
5. The ionosphere is the likely source of charge and energy for all luminous events except those associated with thunderstorms.

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[5] See 3.3.2 and 4.3 for accounts of spherical phenomena that not only follow airplanes but change trajectories abruptly, "fly" in front of aircraft, and perform complex maneuvers nearby. (Ed.)

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