Electric Events on Mars

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The small planet Mars, the fourth planet out from the Sun, has emerged as one of the most promising laboratories in the solar system for exploring the mysteries of electricity in space. The planet now promises to alter the direction of planetary science, removing once and for all the myth of an electrically neutral solar system.

1. Planet of a Thousand Mysteries

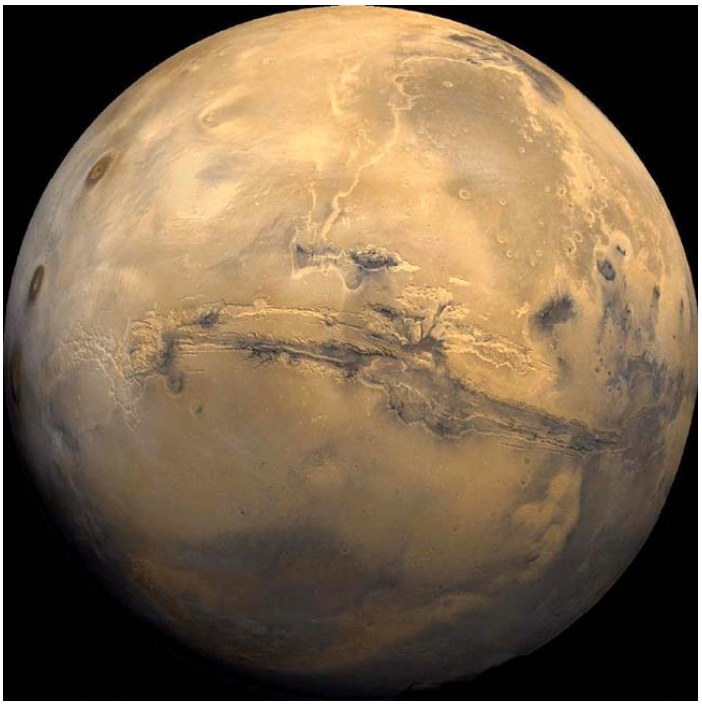

Fig. 1. Mars as seen in 1971, by Mariner 9.

From the first glimpses of the Martian surface, provided by the Mariner 9 probe in 1971, the planet revealed one paradox after another. And the more we learned, the more clear it became that Mars did not fit the textbook picture of a cold and inactive rock ever-so-slowly peppered by random impacts.

Planetary scientists responded by applying three assumptions, all formulated long before the space age began and long before the onrush of new evidence pointing to *electricity's* influence on galactic, stellar, and planetary evolution. They assumed that Mars has moved on a stable orbit for billions of years; they assumed that electricity plays no major role in the evolution of planetary surfaces; and they assumed that present geologic processes on *Earth* are the key to understanding past events on other planets.

In recent years, as Mars has become the focus of intense scientific exploration outside the Earth, all three assumptions have been overridden by new discoveries. Electricity has had a much more active role in solar system evolution than astronomers and planetary scientists had ever imagined. Indeed, the astonishing landscape of the planet Mars alone could force a reevaluation of all popular assumptions about planetary history [1].

2. When Dust Storms Engulf Mars

The spacecraft Mariner 9 was the first probe to orbit the planet Mars. As it arrived at the Red Planet in 1971, NASA scientists were shocked by the view—the most horrific dust storm they had ever seen. The entire planet was engulfed in a deep haze, with only the peak of gigantic Olympus Mons penetrating through the clouds.

For several decades, the energetic dust storms on Mars have posed unanswered questions. How can an atmosphere less than *one percent* as dense as Earth's remove dust from the soil and accelerate it into massive clouds circling the planet up to 40 miles or more above the surface?

In June, 2001, thirty years after Mariner 9, the Hubble Telescope revealed the first stirrings of a dust storm in a small region of the Hellas Basin, a dominating feature in the southern hemisphere of Mars. For several days the storm alternately grew, then retreated. Then it exploded and quickly boiled out of the Hellas Basin, spreading both north and east. Within a few weeks it had covered the whole planet.

Fig. 2. Hubble telescope images show effect of a global dust storm on Mars (right).

The storm did not begin to subside until October. It was the greatest dust storm ever observed on Mars, and it left meteorologists scratching their heads. How was the dust excavated from the surface? What held the dust aloft? What accelerated the winds and dust across the near vacuum of Mars' upper atmosphere to speeds greater than 250 miles per hour? With its Thermal Emission Spectrometer (TES), the orbiting Mars Global Surveyor measured thermal effects associated with the storm. As the storm clouds began to surround Mars, temperatures rose a stunning 40 degrees C—a case of "instantaneous global warming" that continues to haunt meteorologists.

Phil Christensen of Arizona State University, one of the principal investigators of the Martian phenomenon, acknowledged that the specialists do not really know, in "detail," the causes of the Martian dust storms. Some have theorized that as Martian dust clouds grow thicker, they absorb more warmth from the Sun, raising the temperature of the atmosphere—"a positive feedback loop that can transform tiny dust clouds into globe-swallowing storms," as one science writer put it. With this reasoning one might wonder why the dust storms ever stop. Indeed, those following this reasoning are not sure why they *do* stop. ("In fact, we're not certain what makes them stop," stated Christensen.)

Such "explanations" of the dust storms begin with radiant energy from the Sun. It is known that the storms are most frequent and severe when Mars is near perihelion (its closest approach to the Sun). So the specialists concluded that thermal effects of solar radiation must provide the energy of the storms. But this rationale required an *effect* vastly more energetic than the *cause*. Mars' orbit has an eccentricity of 0.093. (That is, its divergence from a perfect circle is very small.) Although greater than the Earth's orbital eccentricity of 0.017, at Mars' distance from the Sun the change has little more than a trivial influence on radiant energy input. In fact, if thermal effects are the cause, then seasonal orientation of the planet's axis should concentrate dust storms in either one or the other hemisphere, depending on the season. This is not always the case, however.

An alternative hypothesis has been well tested by the space age. In the "Electric Universe" model of the solar system, interplanetary currents focused on the Sun play a vital role in charging up planetary ionospheres—and ionospheres are essential to the evolution of weather systems. Electric theorist Wallace Thornhill likens the Earth's atmosphere to the "self repairing, leaky insulation" between the conductive plates of a global capacitor. The conducting ionosphere forms one plate of the spherical capacitor, while the Earth's surface is the other. Lightning occurs on earth because of the the "leakiness" of the capacitor, as currents break through the insulating atmosphere to dissipate charge.

The clear-air voltage gradient of Earth at sea level is about 100 volts per meter. In standard meteorology, it is the electric power of thunderstorms that "charge-up the ionosphere." But the electric theorists see this as an inversion of cause and effect. There would be no thunderstorms in the absence of Earth's electric field.

Since Mars has no thunderstorms, it presents a good case study in the nuances of the Electric Universe. The electrical model predicts that the Martian ionosphere is indeed charged, and the model requires no isolated or local dynamo to "separate charge." On Mars, electrical effects will reach directly from the ionosphere to the surface without the dissipating "leakage" provided by storm clouds that we see on Earth. Unlike radiant energy from the Sun, electrical energy can accumulate in the "planetary capacitor" for some time, before finally breaking down in the initiation of massive discharge activity.

Hemispheric seasons do not seem to be a major influence on the event provoking *global* dust storms. Interplanetary *circuitry,* acting across the plasma of space, may in fact be the primary consideration. The greatest storm on Mars (2001) occurred when the planet was nearing perihelion and the planet was the closest it had been to Earth in about 12 years. At that time it was also being "tickled" by the Earth's plasma sheath, or magnetosphere, establishing a temporary electrical connection between Earth and Mars for the transfer of charge.

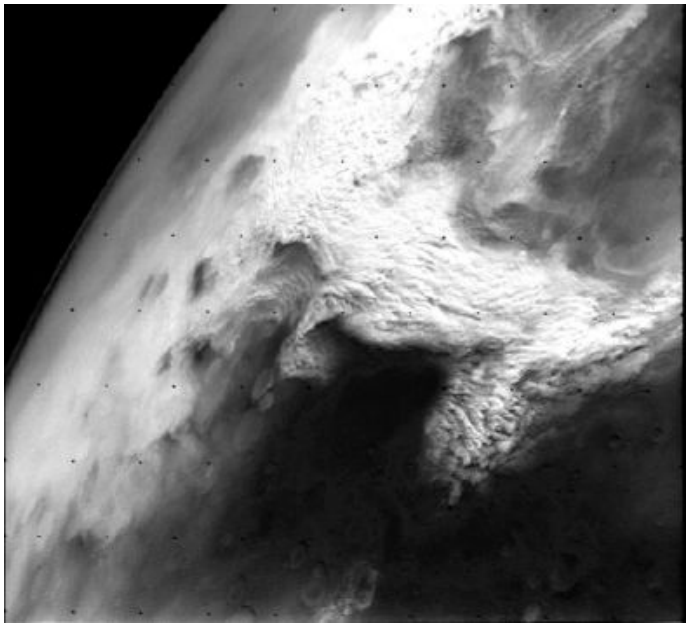

Fig. 3. Martian dust storm front.

It seems that Mars responded with an outburst of atmospheric discharges, these taking the form of monstrous dust devils—or more accurately, electrical *tornadoes*—not an unusual occurrence in the laboratory, where electrostatic discharge has been shown to produce tornadic columns with no dependence on large regions of circulating air. Thus, in an electrified environment, congregations of tornadic columns could be expected.

Ironically, our own Moon may ultimately provide a good illustration of the point, by its monthly passage into the Earth's magnetosphere. According to Tim Stubbs, a University of Maryland scientist working at the Goddard Space Flight Center, this entry "can have consequences ranging from lunar 'dust storms' to electrostatic discharges." [2]

Fig. 4. The congregation of vortices on the leading edge of Martian dust storms is a mystery yet to be confronted by planetary scientists.

The statement is not entirely conjectural. Spacecraft have measured the electric field strength as the Moon passed into the Earth's magnetosphere. Of course, in this case, no one has argued that *thunderstorms*, or atmospheric heating and circulation cause the surprising effects on the Moon. The Moon has no atmosphere. It should also be noted that electrical transactions will not

only account for the high-speed winds in the upper atmosphere of Mars, but explain the associated heating anomalies that have so mystified planetary scientists.

In the Martian dust storm imaged in Fig. 4, it is clear that the dust is being jetted upwards rather than being blown along the surface.

According to Thornhill, closer examination of dust storm leading edges should show that these tornadoes form preferentially on high points and the sharp edges of craters or escarpments.

The twisting columns on the leading edge of Martian dust storms suggest vertical movement that is inconceivable in an electrically inert near-vacuum. The closest analogue to these columns may indeed be the network of twisted filaments seen erupting from beneath the Sun's photosphere, on the margins of sunspots—electric tornadoes, according to Thornhill.

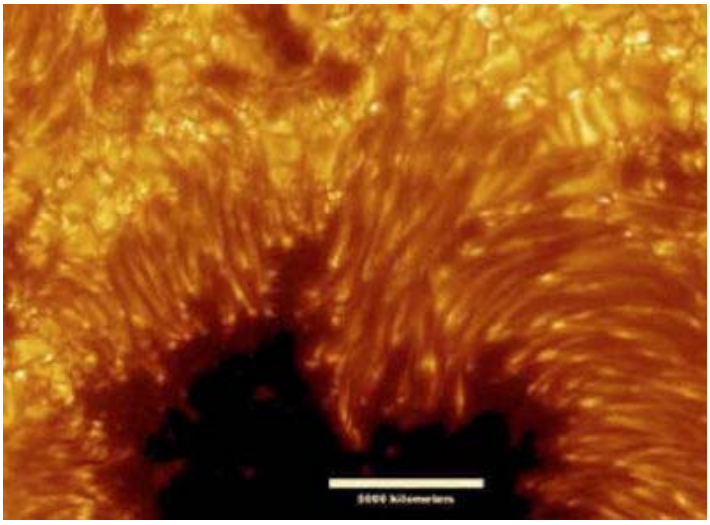

Fig. 5. An eerie similarity between sunspot penumbra and dust storm fronts on Mars could be well worth investigating.

In recent years cameras orbiting Mars have captured numerous images of regional dust storms, and these images must be examined closely for indications of electric discharge. The image shown in Fig. 3 was taken by Themis on November 1, 2004. It shows what NASA spokesmen have called a "dust raising event." In the conventional interpretation, such events must be traceable to the movement of the atmosphere under the influence of temperature changes, with possible modulation of this movement by surface features.

But despite the great diversity of temperature conditions, landscape, and an incomparably more effective atmosphere on Earth, nothing ever observed within Earth's atmosphere matches the close congregations of vortices associated with Martian dust storms.

In the electrical interpretation, the tornadic columns are the signature of electric discharge, as demonstrated in laboratory experiments for more than a century [3].

It is only reasonable, therefore, to look for indications of focused electric discharge on the Martian surface, in relation to the tightly packed vortices now observed. And it seems that visible discharge has already been captured by Themis. A good example is seen in Fig. 6, which is the upper portion of a larger image of a massive regional dust storm. The higher resolution image reveals not just the massive presence of diffuse billowing clouds, but extensive white spots lacking any conventional explanation. Are these the telltale focal points of the discharge activity preceding the formation of regional tornadic columns? As of the present date, the author has been unable to locate any NASA commentary on this image. And it must also be noted that NASA officials have yet to acknowledge that packed vortices, "dust devils" or "tornadoes" are an essential contributor to the regional dust storms on the planet.

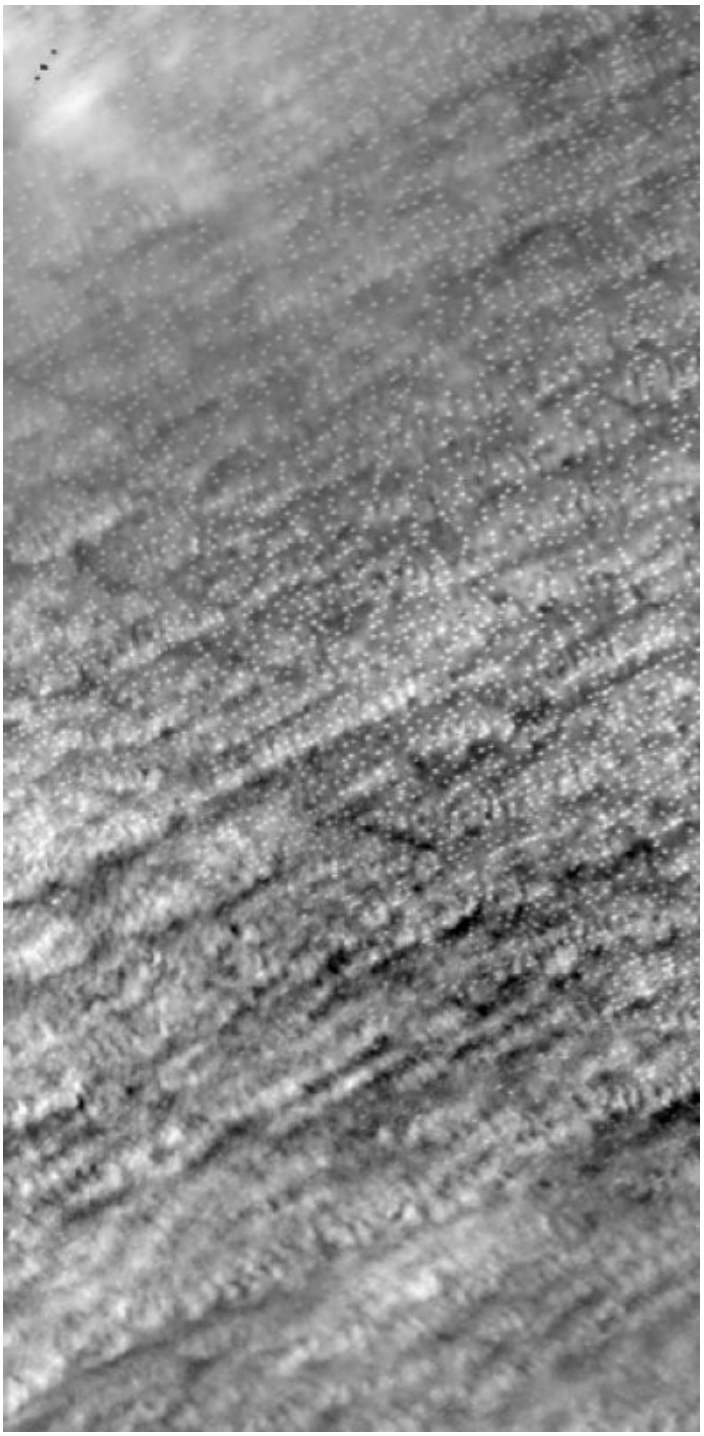

Fig. 6. Dust devils (white spots) beneath the storm clouds underscore the profound scale of electrical events on Mars.

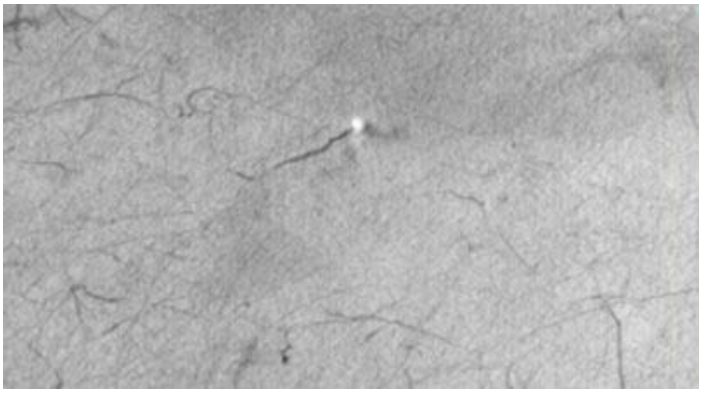

Fig. 7. A dust devil moves across the Martian surface.

Nevertheless, satellite images of isolated dust devil activity on Mars do support the interpretation that the spots in the image in question are nothing more than a congregation of dust devils. The dust devil captured in Fig. 7 is just one of many examples. In the interpretation offered here, the regions of "white spots" are simply the spawning ground for packed dust devils and the billowing clouds associated with a large-scale dust storm--a storm of sufficient magnitude to obscure the ground-level activity once sufficient dust has been raised into the clouds shown in the larger image.

3. Martian Dust Devils: "They're Electrified"

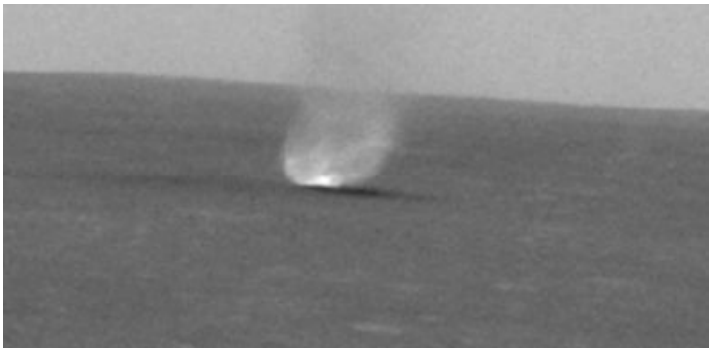

Fig. 8. A Martian dust devil caught moving across the surface

Images from satellites circling Mars provide only part of the evidence bearing on the nature of electrical dust devil activity on Mars. Landers on the planet, most significantly the two Mars Rovers, Spirit and Opportunity, have captured quite a number of separate dust devils in action, and the images are striking.

The Martian "dust devil" in Fig. 8 places an exclamation point on the white spots as seen from space. It is possible that a glow discharge is occurring at the base of the vortex.

Moreover, it seems that NASA is not entirely oblivious to the electrical nature of dust devil activity, though the presence of larger electric fields on Mars provoking such activity is not presently a part of NASA's lexicon—

"When humans visit Mars, they'll have to watch out for towering electrified dust devils." With these words, a NASA news release, dated July 14, 2005, gave official sanction to an idea that has percolated up from separately funded research projects in recent years. The new research involved chasing dust devils in the Arizona desert, where investigators were surprised to find that these vortices are electrically charged. The obvious inference is that Martian dust devils might be charged too. But in 1999, well in advance of this research, the leading theorist of the Electric Universe, Wallace Thornhill, had written based on other evidence:

"Electric discharges from space cause Mars' huge dust devils and planet-wide dust storms."

Fig. 9. Several dust devils cross a plain in this animation of a series of images acquired by NASA's Mars Rover Spirit in May, 2005. Credit: NASA/JPL-Caltech/Cornell/USGS)

A good indicator of electrical discharge from ground to air within a Martian dust devil can be seen in the frames of a movie taken by the rover Spirit as the vortex spun across Gusev Crater just before noon on March 15, 2005. The luminosity of the apparent discharge activity at the base is compelling and may indeed confirm the earlier claim of Electric Universe advocates that the dark tracks left by the tornado-like whirlwinds on Mars are due to electric discharge either scorching the surface or removing light material above a much darker layer of soil. Additionally, we find evidence that dust devils can electrostatically attracting iron-laden dust, to "paint" the dust on the surface, as seen in Fig. 10.

Fig. 10. Planetary scientists continue to puzzle over the dark streaks left by dust devils.

The NASA release described a typical dust devil on Mars as a "monster column towering kilometers high and hundreds of meters wide, 10 times larger than any tornado on Earth." [4] Were an astronaut to come face to face with such a monster he would encounter "red-brown sand and dust whipping around faster than 30 meters per second (70 miles per hour)" as visibility dropped to zero. And the "scariest part" would be the incessant crackling and flashing of miniature lightning, the article reports.

Under popular assumptions, scientists exploring Martian dust devils must locate the cause of the electrical discharges in solar heating and the resulting mechanical energy of air convection. In the Electric Universe, as refined by Thornhill and his

colleagues, rotating columns of air are a natural consequence of atmospheric electric discharge. Rotating columns are the prevalent forms taken by electric currents in plasma. A researcher unaware of the global Martian circuitry involved will be limited to mere discussions of localized charge separation. Effect will be confused with cause. Charge separation will then be attributed merely to the physics of dusty air circulation within a vortex, leaving the vortex itself without a cause.

Thus, the NASA release suggests, "Dust devils get their charge from grains of sand and dust rubbing together in the whirlwind. When certain pairs of unlike materials rub together, one material gives up some of its electrons (negative charges) to the other material … Smaller dust particles tend to charge negative, taking away electrons from the larger sand grains."

In this view, it is a rising central column of hot air that powers the dust devil, carrying the negatively charged dust upward while leaving the heavier positively charged sand swirling near the base. In this way, the charges get separated, creating an electric field.

But this commonly accepted model finds little or no support in the actual conditions on Mars. Atmospheric pressure on Mars is less than *one percent* that of Earth at sea level. Thus, a simple mechanical model, drawing on nothing more than mild warming of the Martian atmosphere, cannot account for the Everest-sized dust devils and global dust storms. In fact a large dust cloud would only serve to *reduce* solar heating at the surface.

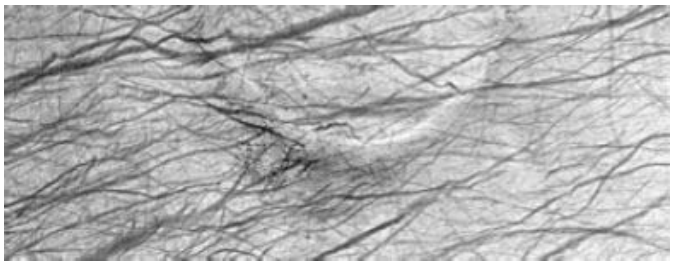

Fig. 11. Dust devil tracks on Mars

For the electrical theorists, the intensity and number of dust devils will be affected both by solar outbursts *and* by the planet's elliptical orbit. When Mars is moving radially through the electric field of the Sun, this movement will be sufficient to generate electrical events on a scale and frequency that would not occur if Mars were on a more perfectly circular orbit. In fact, global dust storms on Mars can be compared to the dust raising events recently witnessed on asteroids moving on an unusually elliptical orbit.

If the electrical researchers are correct, the issue of dust devils on Mars cannot be resolved without addressing a bigger picture. Electric discharges can do what a rarified atmosphere cannot do—remove large volumes of dust, scorch dust black, raise dust into rotating vertical columns, and (in concert with other electrically-driven vortices) generate global dust storms and suspend large volumes of dust in the atmosphere.

The picture of Martian dust devil tracks in Fig. 11 is of special interest. Many of the streaks appear to be chains of dark spots or dots, a pattern reminding us of the darkened rille patterns on Jupiter's moon Europa, which are at times little more than extended crater chains. (See Fig 12.) It seems that prior theoretical assumptions have prevented planetary scientists from noticing the similarity between the dust devil tracks on Mars and the meandering rille patterns on Europa. The similarities extend beyond general appearances.

In both instances we see pits, dimples, or darkened spots, and the repeated association makes clear that the same force created both the streaks or rills and the dark spots (often centered upon the linear markings or impressions). Most of the spots show a generally constant size. Electric discharge is the one force known to create the distinctive effects, including rille complexes, dark streaks, spotting, and the general darkening of the surface in regions of strong electrical activity.

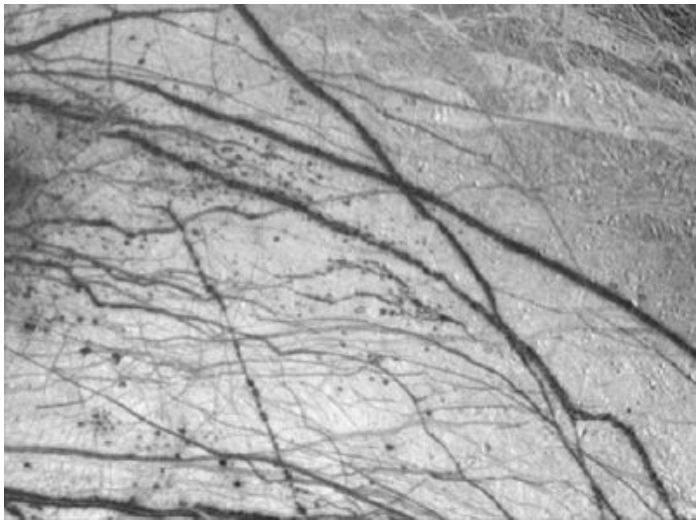

Fig. 12. The image above does not depict Martian dust devil tracks. It shows the surface of Jupiter's moon Europa, whose spotting and linear rilles are, according to electrical theorists, the markers left by electric discharge.

4. The "Gullies" of Russell Crater

A bizarre complex of channels on the south-facing bank of a "sand dune" on Mars provides additional indications of electrical events with the power to create surface features for which no other explanation is possible.

The massive "sand dune" in question lies in Russell Crater, 55 degrees south latitude. The channels reach downward from the crest of the formation, occupying its southward face. The trenches appear to be fresh, and unlike older features on Mars they show virtually no deposits of circulating dust beyond the changing levels necessary to create surface darkening. When considered through the lens of popular assumptions, these channels are a baffling mystery.

The first enigma presented by the ravines is the surreal appearance of the entire complex—an anomalous but repeated pattern. Numerous tributary networks, each a virtual copy of its neighbors, feed sharply defined channels running down the embankment. The bizarre repetition of an exotic pattern appears to defy all familiar erosional regimes. Fluid flow is typically subject to much more random tributary systems and irregular, non-systematic distribution.

In contrast to normal fluid flow, most of the ravines maintain a consistent width, then terminate abruptly, each traveling roughly the same distance as the others. Each "gully" presents a levee that neither grows nor diminishes along its path. No breach

of ravine walls is evident. No indication of outflow, typical of liquid flowing down a steep incline, can be seen.

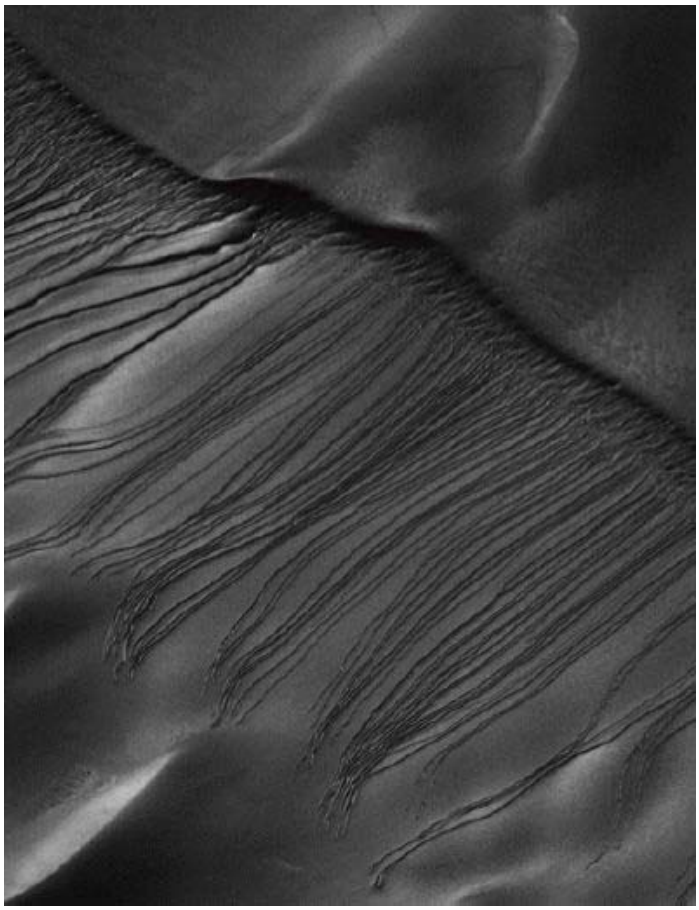

Fig. 13. A complex of pristinely carved channels on the dunes of Russell Crater.

Unusual but recurring patterns standing side by side are a good indication that an unusual answer is called for. In this case, that means an answer reaching beyond the effects of fluid flow and erosion. As demonstrated in decades of laboratory research, recurring patterns are extremely common in plasma discharge behavior. And since plasma discharge appears to be directly involved in generating the dust storm and dust devil activity previously noted, it is certainly reasonable to ask whether these remarkable channels might also find an electrical explanation.

A fascinating counterpart to the Russell Crater gullies occurred in an experiment by Bill Beaty, a distinguished and award-winning electronics hobbyist. He produced a trough in a layer of carbon dioxide "fog" by directing beams of protons at the layer from a human hair about 1/4 inch long. Fig 14 is a photo of one of the troughs remarkably similar to the enigmatic Martian ravines, including the "levees" and their abrupt termination.

Could positively charged particles be responsible for the channels under consideration? There are, in fact, dozens of reasons to consider this possibility--all interconnected and all pointing to something that NASA scientists have yet to take into account--a charged planet moving on a modestly elliptical orbit within the electric field of the Sun.

Planetary scientists do not understand why the highly filamentary channels of Russell Crater tend to lie only on a south-facing slope of a massive "dune." But this is, in fact, another clue suggesting the electrical nature of the formations. In the electrical interpretation, positively charged particles from the Sun are entering the Martian ionosphere and following magnetic field lines to the surface. (NASA scientists are finding that localized magnetic fields are much more prominent in the southern hemisphere than the northern hemisphere.) In the absence of a substantial insulating atmosphere, such ion or proton beams could indeed account for the troughs in the Russell Crater "dune" field.

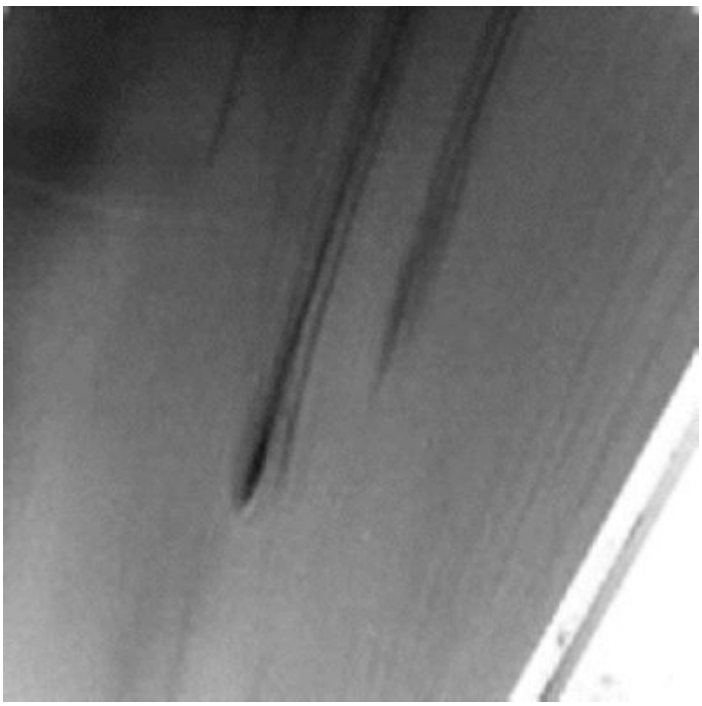

Fig. 14. Experiment by Bill Baity, creating channels in carbon dioxide fog with proton beams.

In evaluating a new hypothesis, the acid tests must focus on predictive power—the ability of the hypothesis to account for things left unexplained by prior theory. Electrical theorists do not consider the standard descriptions of the Russell Crater "gullies" to be plausible. Rather, they have viewed these troughs as a "bundle of predictions" awaiting confirmation. Working from general to specific, the electrical interpretation suggests the following:

- Reliable explanations for atmospheric and geologic events on Mars will come from a practical understanding of electric discharge effects.
- Plasma discharge--from electrostatic sculpting to particle beam effects and spark machining—is altering the surface of Mars year by year.
- The channels on Russell Crater dunes are not the result of flowing liquid.
- No evidence of flowing liquid will be found.
- When viewed more closely it will be seen that the channels do not follow topography in the fashion of flowing liquid.
- Since the channels are carved into a smooth surface (i.e., a surface not strewn with boulders and rocky rubble), the immediate surroundings should have preserved more subtle

evidence of particle beam activity, electrostatic sculpting, and glassification.

- Cratering in connection with channel formation must be anticipated, particularly at the starting points and terminations of the channels.
- The events creating the troughs are almost certainly connected to other enigmatic events in the immediate vicinity and in the larger region of the southern hemisphere.

Thanks to recent high-resolution images taken by the HiRISE instrument, it is now clear that conventional "explanations" of the Russell Crater channels can no longer be maintained.

HiRISE images have provided the highest-resolution image of the Russell Crater ravines and related features. For a critical observer, a close-up look at the formations should eliminate once and for all the idea that these "gullies" were created by fluid erosion. A huge HiRISE image of gullies and surrounding area can be accessed selectively by zooming in on any region—

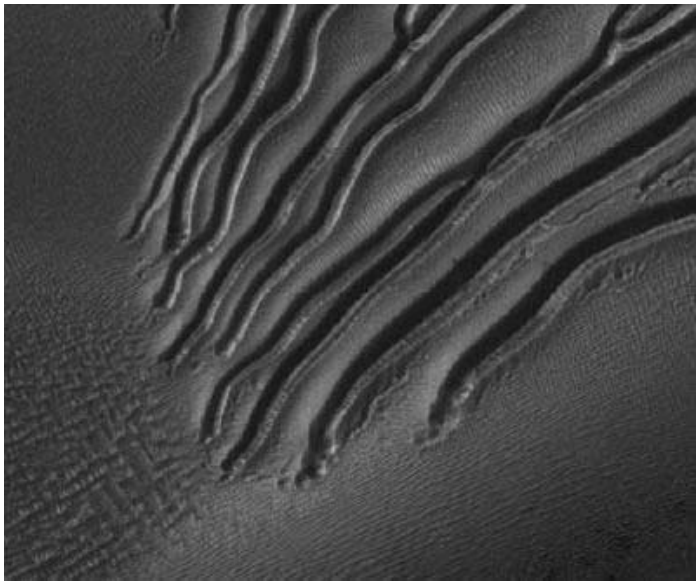

Fig. 15. HiRISE image of the Russell Crater dune channels

The images provide stunning new support for an electrical interpretation. Channels cut by electric discharge machining will often produce associated cratering and crater chains, as seen in Fig. 15. Though the ravines all run downhill, the higher resolution images show that they do not consistently follow topography in the fashion of fluid flow. In electrical terms, that is not surprising. The channels reveal no breeches of levee walls and no outflow at their termination. Within the channels themselves, no evidence can be found of sediment or debris being carried along by fluid. Many of the channels terminate in cleanly cut craters.

The "fishbone" formations below the channels find counterparts in lightning scars, and finely cut transverse grooves along the channel walls are diagnostic of the filamentary coronas of electric arcs.

Indeed, it is no exaggeration to say that every defining feature of the Russell Crater anomalies, though challenging standard theory, has an undeniable analog in electric discharge scarring.

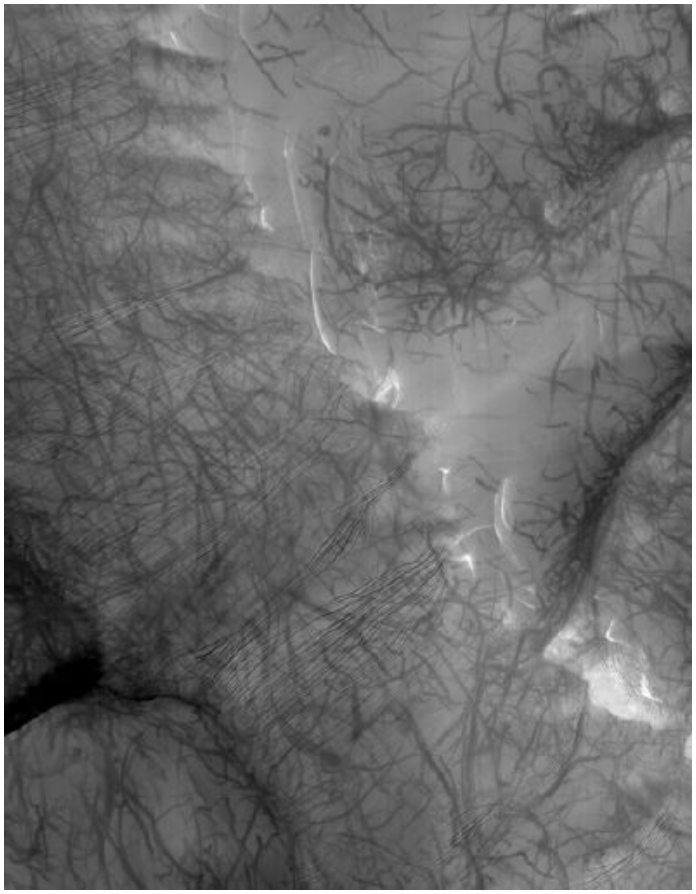

Fig. 16. This extraordinary HiRISE image of the Russell Crater "sand dune" shows both the rille network and the surrounding area covered with dust devil tracks. Virtually none of this activity was evident when the image presented on page 15 was recorded. The selectively removed dusty surface, creating white streaks, is also a strong indicator of focused electrical activity.

Of course, these considerations are not on the minds of the specialists analyzing the images, because they are still bound by the "electrically neutral solar system." Here is what the HiRISE team has to say about the dramatically enhanced view of the ravines:

> "Hundreds of enigmatic small channels are seen to carve into the slopes of these dark sand dunes lying within Russell Crater on Mars. These features were previously identified as gullies in images from the Mars Orbiter Camera (MOC) on Mars Global Surveyor, but the higher resolution HiRISE image brings out many new details and mysteries."

And yet, immediately after this acknowledgment an imprisoning theoretical assumption rears its head.

> "The channels extend from near the top of the dunes to their bases, indicating that some fluid material carved into the sand. The channels commonly begin as smaller tributaries joined together, suggesting several sources of fluid."

It seems that obsolete assumptions still condition today's scientific observations, so that in the case at hand everything remains an anomaly: "Distinct dark spots are located near where the channels seem to originate. Several channels appear to originate at alcoves. Several of these channels have sinuous middle

reaches while others are straighter. Further down slope, some channel edges appear elevated above the surrounding terrain, particularly in the lower reaches. The channels seem to terminate abruptly, with no deposition of material, unlike at the bases of some other gullies on Mars that are not on dunes."

It is a tragedy that planetary scientists, working with stunning technological achievements, have been unable to break free from prior theoretical constraints.

5. Mars Rovers Receive a 'Miraculous' Cleaning

Speculations were rampant, but it seems that no one could say for sure what mysterious force or event cleaned the solar panels of the Mars rovers during the remarkable duration of their mission on Mars.

Two rovers—Spirit and Opportunity— landed on Mars in January 2004. When their missions began, their solar cells were providing 900 watt-hours of electricity per day. But over the months that followed Spirit's output dropped to 400 watt-hours daily, while Opportunity dropped to about 500 watt-hours. The primary reason for the drop was the accumulation of dust on the panels.

In fact, NASA scientists had anticipated this rapid decline in electrical output, due to the enigmatic dust levels in the Martian atmosphere. The rovers were designed for a lifetime of just 90 days of activity

But then, in one of the great surprises of the rover missions, Opportunity's power began to increase, and kept on increasing until the power peaked at just over 900 watt-hours.

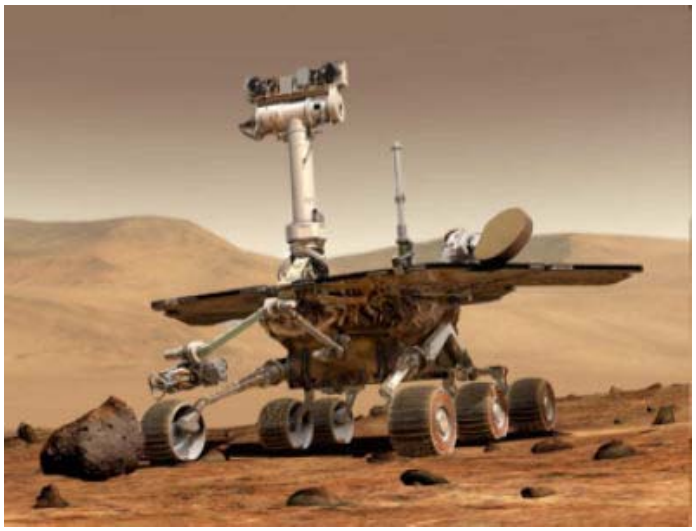

Fig. 17. Artist's rendering of a Mars Exploration Rover.

As reported by Newscientist.com, the Mars rover Opportunity "stumbled into something akin to a carwash," which somehow "cleaned" its solar panels. Jim Erickson of NASA's Jet Propulsion Laboratory admitted that the cause of this surprise "cleaning" could not be explained. "These exciting and unexplained cleaning events have kept Opportunity in really great shape," Erickson said.

The remarkable cleaning occurred in spurts during the Martian night. The team managing the rover reports that on at least four occasions over a six-month period, the rover's power output suddenly increased by up to 5% in a single night.

The rover Spirit experienced similar episodes of "miraculous" cleaning, shocking NASA investigators. What had looked like a predictable end of a mission, was suddenly transformed into a new lease on life. But six years later, the rovers were still working away on the surface of Mars—an unbelievable life extension.

How could any of this be explained? Some suggested that the Martian winds might have swept the dust off the panels. Others wondered if frost could have caused the dust to clump, exposing more of the panels. And some even suggested that the tilting of the rover while climbing hills might have caused a portion of the dust to drop off.

Such guesses are unnecessary, say advocates of the Electric Universe. Winds alone do not clean dust from smooth surfaces, even on Earth, where the atmospheric density is more than *one hundred times* that of Mars. Tilting a dusty surface does not clean it either!

Opportunity landed in Meridiani Planum. Dust storms frequently engulf the region and dust devils five miles high range through it. Moreover, the discovery that dust devils on Earth have strong electric fields obligates theorists to ask if the Martian dust devils--ten times bigger than their terrestrial counterparts—are indicative of an electrified atmosphere capable of both depositing and removing dust from the rovers' panels.

Given conditions on Mars, it is exceedingly likely that Martian dust is charged with static electricity. Just as static electricity can stick dust to an object, it can remove dust. "Electrostatic cleaning" is, in fact, a common and effective industrial application. All that's needed is to change the voltage. In the electric field above Meridiani Planum, voltage will vary with altitude. The most marked cleaning episodes occurred when the rover was climbing the rim of Endurance crater. And of course, in an electrified atmosphere with massive electrical dust storms periodically arising, numerous changes in ambient charge would be certain to occur.

From the electrical perspective, the robots' seemingly unfathomable endurance is easily explained as an effect of repeated electrostatic cleanings. On Mars, because of the atmosphere's thinness, dust particles charge more easily and will stick more "stubbornly" to a surface. Thus, the notion of repeated cleanings in the absence of the electric force becomes all the more preposterous.

Ironically, a number of researchers have posited that the best cleaning method for removal of dust from power systems on Mars will involve electrostatic applications. At the 2002 Photovoltaic Specialists Conference, G.A. Landis and P.P Jenkins presented a paper, "Dust Mitigation for Mars Solar Arrays," dealing specifically with electrostatic cleaning: "The environment of Mars is expected to be an ideal one for use of electrostatic dust-removal techniques."

Indeed, in the late 90s, under NASA's own auspices, specialists had produced what was called the "Dust Accumulation and Removal Technology" (DART) for the Mars 2001 Surveyor Lander. In a report to NASA, the team responsible noted that "Dust deposition could be a significant problem for photovoltaic array operation for long duration missions on the surface of Mars. Measurements made by Pathfinder showed 0.3% loss of solar array performance per day due to dust obscuration." [5]

As it turned out, the DART experiment was never implemented. The Mars Surveyor 2001 Lander was cancelled in May 2000 after the failure of two projects, the Mars Climate Orbiter and the Mars Polar Lander, in late 1999. But the entire situation is fraught with irony. Within the technical support teams of NASA itself, there has been sufficient expertise to recognize the principle of electrostatic cleaning, and to see exactly what has occurred in the case of the Mars rovers.

And yet, in all of the wonderment over the "miraculous" cleaning of the rovers' solar panels, one searches in vain for any reference to "electrostatic cleaning" or "electrostatic dust removal." It is as if what is obvious to electrical specialists remains unknown to the astronomers, astrophysicists, and planetary scientists, who today dominate the discussion of Mars within the popular scientific media.

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