

How Sun Spots Touch Off Our Volcanoes

The Recent Disastrous Eruptions in Java, Japan and Central America, Traced by Science to the Bombardment of Earth by Magnetic Storms From Solar Cyclones

By Dr. W. H. Ballou.

THE remarkable coincidence between periods of intense sunspot-activity and volcanic eruptions on earth has long been noted by vulcanologists and astronomers. While for years it has been hinted that some connection must exist between these two phenomena, it is only now that science is able to say definitely that such connection does exist and to hazard explanation of how solar cyclones millions of miles away from us can touch off our own volcanoes.

There is at present on our sun the most gigantic spot ever noted. This disturbance revolves around the northern limb of the sun and is estimated to be from 50,000 to 100,000 miles long. It has just been accompanied by a second and smaller spot.

Simultaneously with the appearance of the first spot there began various disastrous eruptions in volcanic regions through the world, and these are still continuing.

The explanation now put forth is this: These unthinkable huge sun cyclones are in effect unthinkable gigantic dynamos. They cast out into space, sometimes for a million miles, flames of gas and semi-solid matter. But they also release tremendous floods of particles of electricity and cataracts of that peculiar energy we call magnetism. The earth itself has been compared by Flammarion, the famous French astronomer, to an enormous magnet spinning in space. When it becomes supercharged from the sun various strange things happen.

One of the usual things is the aurora borealis. All the beauties of the aurora and all its phenomena can be counterfeited in the laboratory by passing magnetic currents through certain rare gases found in the higher strata of our atmosphere. The aurora is apparently the effect of this tremendous storm of electrified particles striking our earth and passing on its way to both northern and southern magnetic poles the layers of these gases high in our air. Sometimes these storms from the sun are so great as to put the entire telephone and telegraph system of entire countries out of business.

But how do they set off the volcanoes? Volcanoes are vents—chimneys, in fact—leading up from portions of the earth in which is gathered molten incandescent matter. These chimneys sometimes become stopped up and then the volcanoes become what we call inactive. They are like gigantic bottles, firmly corked, but in which a ferment is stirring. Invariably these pockets and masses of incandescent matter have above them great chambers in the rock which are filled with high explosive gases. These gases press continually against the "cork" of the crater.

It is now asserted from experiments recently made upon similar gases through which have passed, magnetic currents of varying degrees, that the magnetic waves sent forth by the sunspots penetrate to these chambers and enormously expand these gases. These, expanding, thrust themselves against the core of matter in the shaft of the volcano, forcing it out. The pressure then being relieved, the incandescent matter has nothing to hold it back, and we have our volcanic eruption.

The present sun spot more particularly affected the volcano Kalnui of Java, which, the last official reports state, killed something like over 8,000 people residing around its base. It hit next hardest the volcano Itzaco, in San Salvador, Central America, nearly destroying for the second time the city of San Salvador. After that it affected most severely a volcano of Japan, the explosions of which burst a great reservoir, flooding a considerable territory and drowning the inhabitants.

It was also the cause of lesser, but very damaging outbursts elsewhere in the equatorial region—almost entirely around the globe. The question that puzzles vulcanologists is, why the volcanoes of the equatorial region were affected rather than the volcanoes of Alaska and other regions. This question is a big one, since other sun spots have likewise affected different regions at different times, but never all of the world's volcanoes at one time.

It can only be presumed that the position of the sun spot on the sun, which is seldom the same, has everything to do with the position of the volcanoes on the earth which will respond in kind. It may be that the molten mass within the earth is of changeable position, and that, at the time of the outburst of the present sun spot, the earth's molten mass was then located beneath the equator, or at least was most ready for an eruption at that position. This view would imply that our own interior molten mass forms at different times at different places, and that those places respond with eruptions at the point of the greatest intensity of the prepared molten mass.

the Bombardment of Earth by Magnetic Storms From Solar Cyclones

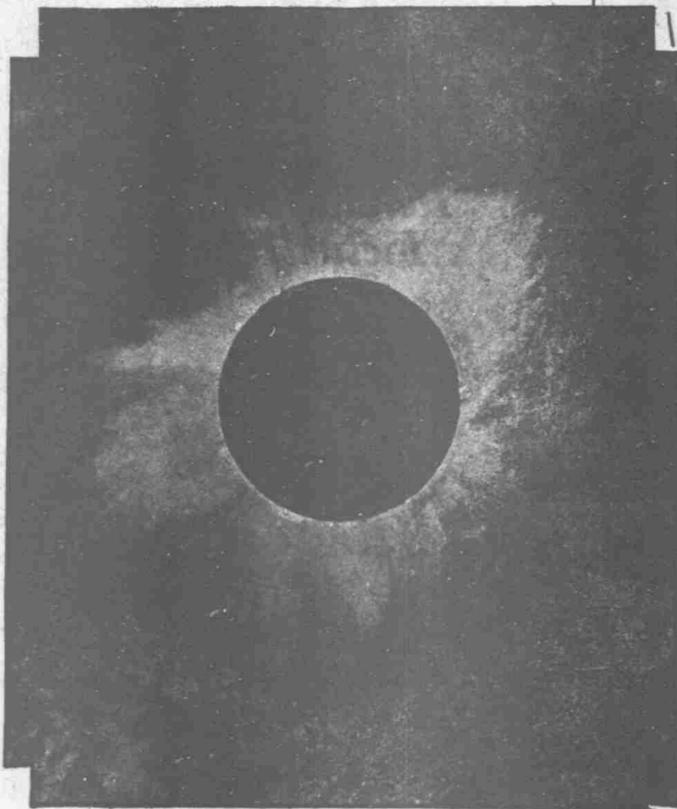


Photo from Museum of Natural History

The Eclipse of June 18, 1919. This Remarkable Photograph is from the Painting of H. R. Butler, Presented to the American Museum of Natural History. The Weird Streamers of the Corona Shown Here Are Supposed to Be Largely Electrical Manifestations, Under Whose Influence Earth and All the Planets Constantly Exist.

It is natural to presume, for instance, that had there been any molten mass ready beneath Mt. Katmai, Alaska, it also would have erupted when the present sun volcano erupted. The matter is emphasized by the appearance of the second sun spot which has caused the eruption of Shishaldin Peak in the Aleutian Islands, and Mt. Pavloff in Alaska mainland.

That sun spots and volcano eruptions are simultaneous has been worked out by E. Kluge, Joseph O'Reilly, Charles Zenger, H. I. Jensen and others. Among the coincidences were the great sun spot outbursts of 1883, 1902 and 1912, and the volcanic eruptions of vast destruction of Krakatos, Mt. Pele and Mt. Katmai, respectively.

Here there was a different effect of the smaller sun spot. Following the appearance of this, the country suffered nine to eleven days rain of very destructive force. Tornadoes beset the country, causing great damage, and there were unusual floods. Obviously, a small sun spot has not only magnetic force enough to affect volcanoes, but is able to stir up the air currents of earth to tornadoic force.

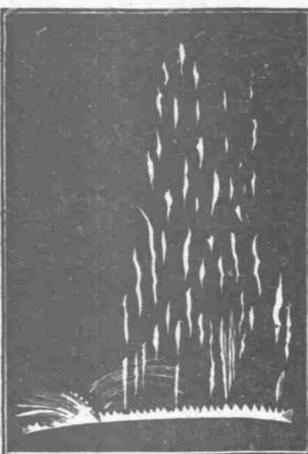
Charles J. Kullmer, a high authority on this subject, has given the following explanation:

"In the belt of the northern United States and southern Canada, where storms on the average are most numerous, the number of storms varies almost directly in harmony with the number of sun spots, just as is the case with tropical hurricanes. In other areas, however, just the reverse seems true, and there is a decrease of storminess. The general conclusion seems to be that, when sun spots are few in number, cyclonic storms move in a great variety of tracks, but when the spots are numerous the storms tend to confine themselves to a few well defined tracks, so that storminess is more or less restricted to certain areas within which it is highly concentrated."

The latest explanation of sun spots is given by Dr. Harold Jacob, of the chair of astronomy of Columbia University, in his new work, "Popular Handbook of Astronomy," as follows: "The size of sun spots is determined by measuring their angular diameters, and then computing their linear dimensions from our knowledge of the sun's distance. Our knowledge of the cause of them is less certain. They are to be

regarded probably as solar atmospheric disturbances, or storms. In that case we should expect them to shift their positions on the sun's surface, much as storm centres move across the earth. And we find by observation that all sun spots do have a common drift; that those near the solar equator drift toward it, and that those far from the solar equator drift toward the poles.

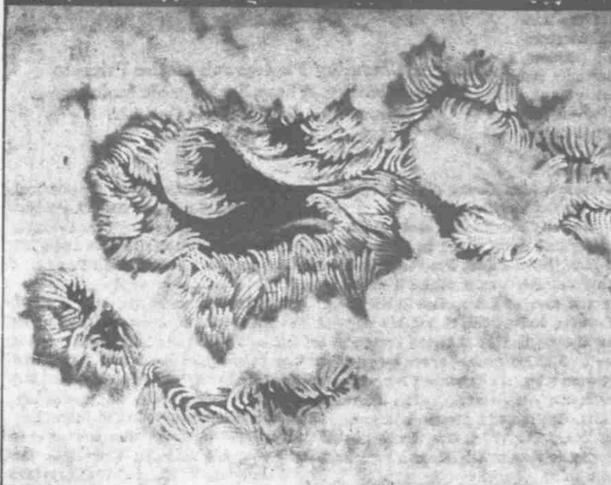
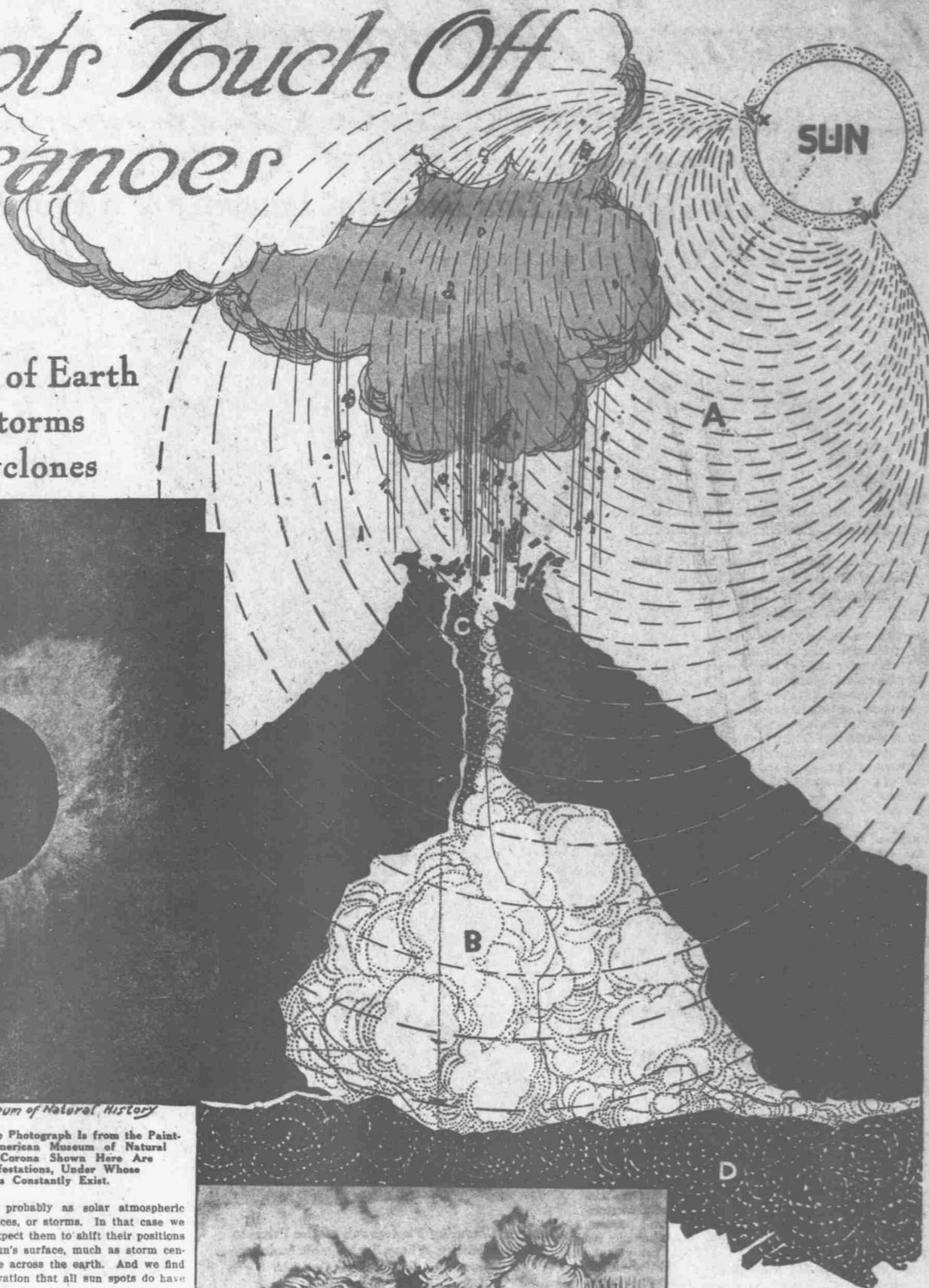
"This might be analogous to our phenomena of the trade winds, especially as spots never occur near the solar poles or



A Solar Eruption Observed by the Astronomer Young. Its Rate of Ascent Was 400,000 Miles an Hour and It Created the Famous Magnetic Storm of 1878 on Earth.

exactly at the equator. They may be eruptions from the interior; or they may be gases running downward into the hollows. One cannot help but think of them as vast storms of some kind—descend gases, moving with great velocities and at enormously high temperatures. "The duration of a spot is never more than eighteen months. Its umbra, or blackest spot, is not really dark, but appears so through contrast with the much more luminous material surrounding it. Schwabe

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A Sun Spot Highly Magnified. The Plume-like Sides Are in Reality Enormous Jets of Incandescent and Metallic Vapors Stretching Hundreds of Thousands of Miles Out into Space and at a Temperature of 17,000 Degrees.

found that every eleven years there is a period of extra great spot frequency. These periods correspond with our eleven year periods of magnetic storms and disturbances and displays of aurora borealis. The intimate relation of magnetic disturbances by earth and sun has not yet been explained. The sun's linear diameter is 900,000 miles, or 110 times as long as that of the earth. Its mass is about 330,000 times that of the earth's mass. Its gravity is such that a pound weight from the earth would weigh twenty-eight pounds on the sun. Its volume is 1,300,000 times that of the earth's volume. If a cubic foot of the sun's material were brought to earth, it would weigh only about one and one-half times as much as a cubic foot of water.

Beyond the photosphere and the reversing layer of gases is the chromosphere, or color sphere, composed principally of great flaming masses of red hydrogen vapor. Sometimes great red jets burst outward to immense elevations from the solar surface. These are called prominences, which intermingle at their boundaries and melt into each other without sudden interruptions. The corona, seen when the sun is eclipsed (with light streamers declared by Todd to

extend 2,000,000 miles into space) we merely know to be an incandescent gas. The form of the streamers indicates that the phenomenon may be electric or magnetic. The solar sun spots seem to cross the solar disc from east to west. One of them makes a complete rotation, disappearing at the western, and later reappearing at the eastern, edge of the sun in a true corrected axial period of twenty-five and one-half days."

The temperature of the sun is given as ranging from 6,000 to 7,000 degrees Centigrade. This gives some index of the power required to thrust its heat ninety-three million miles through space to the earth and prevent our roasting or freezing. Professor H. Helm Clayton, of the Argentine Meteorological Service at Buenos Aires, has issued a paper through the Smithsonian Institution on the variations of solar radiation. Naturally, he finds that the sun's heat hits strongest at our equator. He says:

"The most probable explanation is that tropical areas, and especially tropical land areas, are the parts most heated by the increase of solar radiation. This heating causes an expansion of air over the

How Magnetic Waves From the Sun Spots "Explode" Our Volcanoes. The Curving Lines Indicated by "A" Show Magnetic Storms Issuing From Sun Spots "XX." These Magnetic Waves Pass Through Space and Through Earth, Reaching Pockets of Gas "B" in Volcanoes They Are Supposed by Science to Set Up an Intense Electrical Action Which Expands the Gas, Which Thereupon Forces Its Way Through the Hard Core "C" That Has Formed in the Crater of the Volcano, Throwing It into the Air and Opening the Volcanic Vent. When This Is Accomplished the Incandescent Matter "D" Underlying the Gas Pockets Rises and Shoots Out of the Crater, Just As a Charged Liquid Froths Out When the Top of a Bottle Is Removed.

tropics and an overflow toward the temperate zones, particularly toward the cooler ocean areas in this zone. The final result would be a fall of pressure in the tropics and a rise in the temperate regions, causing an intensification of the normal pressure belts of the earth.

"For example, in the central United States the pressure is low in early Summer, with an excess of southerly winds, while in Winter it is high, with an excess of northerly winds. It is hence conceivable that the same change in solar radiation might have an opposite effect in the two seasons, showing a positive correlation in the one and a negative correlation in the other."

Under this theory, a New York hot wave doesn't come from direct rays of the sun, but is heat gathered in the upper layers of the air over the equator and thence is transferred to northern latitudes. It explains, also, why the heat of the sun is not just as hot and uncomfortable on one day as another.

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