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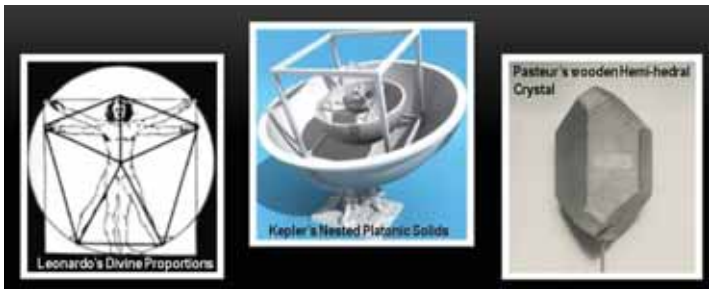
Educating the Mass Strike: Cosmic Radiation beats Green Fascism

Louis Pasteur

By Noelene Isherwood Part 3 of 4

The Geometry of Living Processes

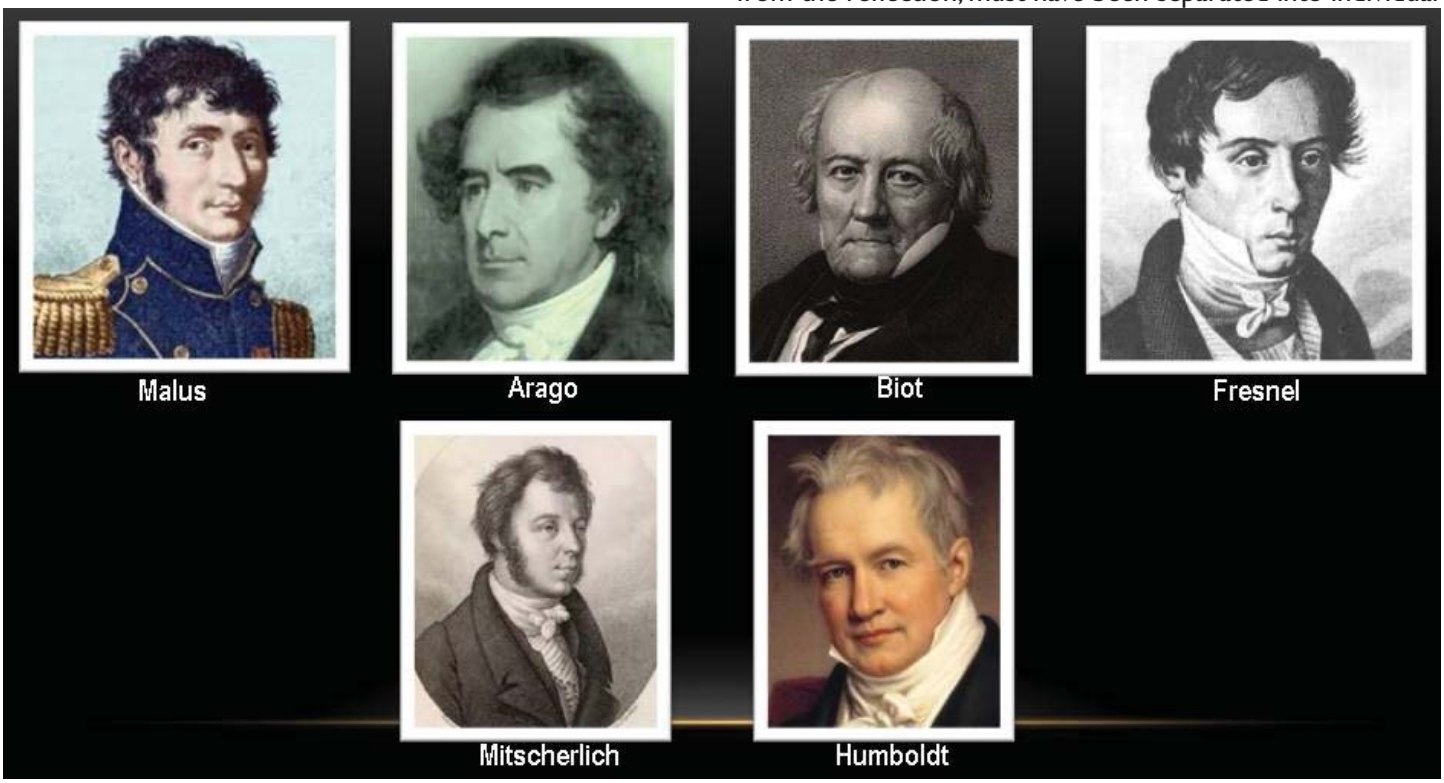


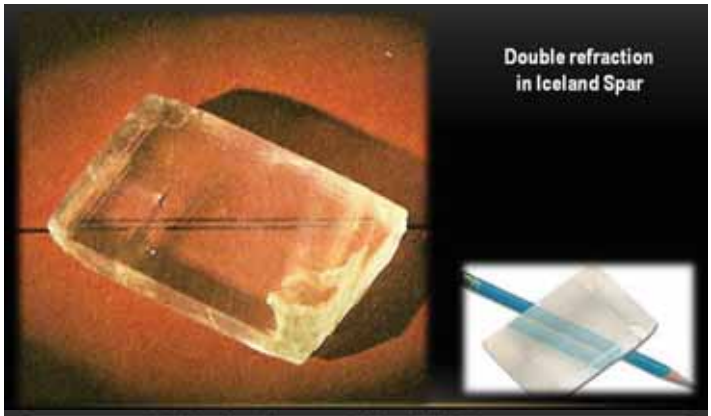
Little could Pasteur have known just how providential for mankind, this decision would turn out to be! By the time he was 26 years old he had conducted ground-breaking experiments on tartaric acid which led to the breakthrough on what was to become known as *Isomerism*, and in particular the *dissymmetry* of living organisms. The discovery of this universal principle set the stage for new higher-order discoveries by Pierre Curie and Vernadsky. But first, Pasteur's discovery.

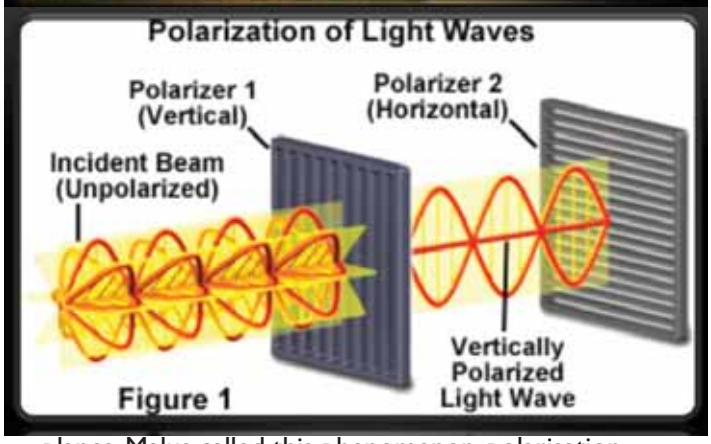
There were a number of breakthroughs in the study of Light, as well as the realm of physical constructive geometry as it applies to biology and of living processes, which laid the foundation for Pasteur's work. This geometric tradition stretched back through the famous Ecole Polytechnique to Leibniz and Christiaan Huygens, to Kepler, Leonardo da Vinci and Nicholas of Cusa. Most characteristic of this scientific tradition is the construction of actual geometric models (like some of those you see here) to demonstrate the way in which processes work in nature. [Note that this approach to understanding the shape of space and living matter also flourished at the Gottingen University in Germany through the work of Jakob Steiner and his student, Bernhard Riemann, simultaneously with Pasteur's work.]

Pasteur's discovery would not have been possible however if not for the next generation of Ecole scientists who applied Gaspard Monge's "descriptive geometry" language to the field of optics. They included Etienne-Louis Malus (1775-1812) Francois Arago (1786-1853,) Jean-Baptiste Biot (1774-1862) and Augustin Fresnel (1788-1827) and their German colleagues Alexander von Humboldt (1769-1859) and Eilhard Mitscherlich (1794-1863). Between them they discovered the phenomenon of polarised light, established the concept of "optical activity" and invented the principal scientific instrument that Pasteur utilised for his optical experiments—the polarimeter. Their work established the modern scientific understanding of light beam optics and spectroscopy on a firm geometrical, non-empiricist foundation.

Now, it was known, thanks to Huygens and Leibniz, that a crystal of Iceland Spar creates a double refraction as light passes through it. Watching the sun set through Iceland Spar, Etienne Malus noticed that the two beams that normally appeared in the crystal were there, but as he rotated the crystal, one of them slowly disappeared and then reappeared as the other one subsequently disappeared. He hypothesised that the vibrating light beams coming through the crystal, and the light from the reflection, must have been separated into individual







planes. Malus called this phenomenon, polarisation.

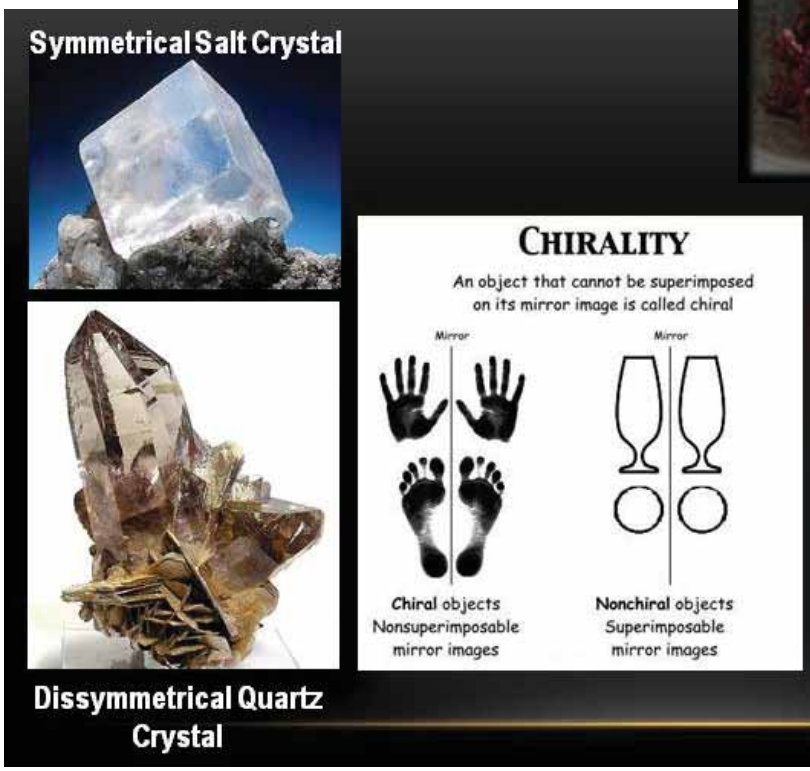
We don't use Iceland spar today to polarize light but it is essentially the same—by blocking all the light waves except for in one direction, we can create a plane of polarised light.

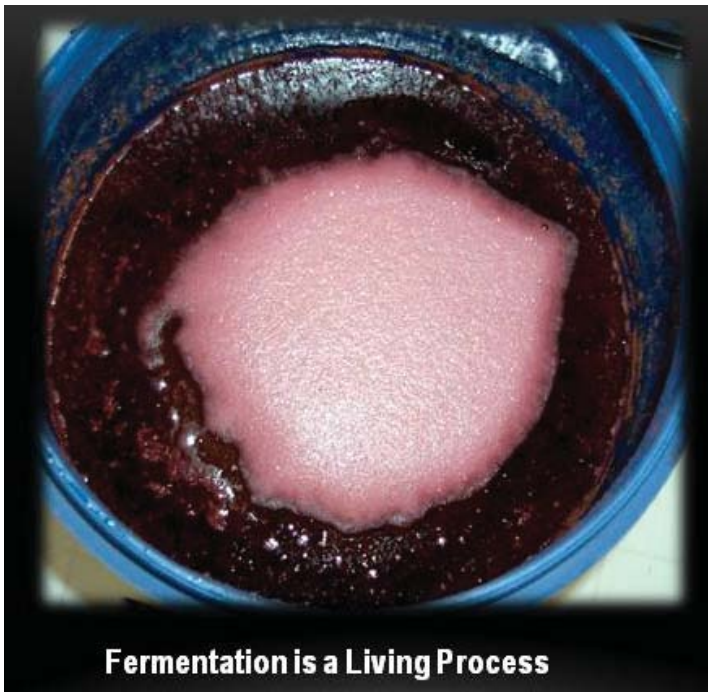
Regarding the Polarimeter: This is a machine that measures the "Optical Activity" of a particular material, or substance—ie. their ability to rotate the plane of polarised light. To see how the polarimeter works, if you have an old pair of "polarizing" sunglasses, you can do your own experiment. Take the lenses out and place one lens in front of the other. Then look at a light source (not the Sun preferably) through the stacked lenses. Rotate one lens and observe that the brightness of the light passing through goes from a maximum to a minimum over a range of 90 degrees rotation. When the second lens is aligned in the same direction, light passes through easily, but if it's rotated 90 degrees, virtually no light can get through. That's the principle of the polarimeter. A polarizing lens at one end only transmits light that is vibrating in a vertical plane. The light passes through the test solution and may be rotated to the right or left to varying degrees, which can be measured directly by rotating the second lens until the light transmitted is at a maximum again.

For centuries, it was known that a natural acid found in grapes, tartaric acid, formed salts, called tartrates, which crystallized in wine vats. You may have seen these crystals on the cork in a bottle of wine. It was known that a solution of tartaric acid rotated polarized light, but it was not known why. In 1819, a second, very rare, form of tartaric acid crystals was identified known as Paratartaric or Racemic acid. Both the Tartaric acid and the Racemic acid had exactly the same chemical composition and properties, indicating that the arrangement of their atoms should be identical.

However, in 1844, Eilhard Mitscherlich, the German chemist from Gottingen University, sent a report to the French Academy of Sciences describing how these crystals, though seemingly identical, had different effects on polarized light. When polarized light was passed through solutions of Racemic acid crystals—NOTHING HAPPENED but when passed through Tartaric acid, the light rotated. This paradox created a tremendous debate in the chemical community. If every test known to science indicated that the two compounds were identical in every way, what could cause this difference?

Well, as Pasteur said**:** *To be astonished of anything is the first movement of the mind towards discovery.* He took up the challenge





Out of the two possible handed forms which compose the racemic acid it was as if the yeast—which Pasteur hypothesised might be a living process—had literally consumed all the right-handed tartaric acid and had no appetite for the left handed form. How was the yeast distinguishing between the two forms of the acid? Did every yeast have its own polarimeter to test the food before eating it? Pasteur understood that here was perhaps the clearest distinction between life and non-life.

Under all *non-living* conditions, that is without a process of fermentation acting on the racemic acid, the left-handed and right-handed tartaric acids behave identically in all respects, except for the direction in which they rotate light. However, to a *living process* such as fermenting yeast, the two forms are as different as night and day. Therefore natural tartaric acid which is uniquely a product of living or organic processes will always display a left-handed chirality, whereas racemic acid which is not a product of organic processes will not.

One of Pasteur's old mentors, Jean-Baptiste Biot asked Pasteur to repeat his experiment. Pasteur reported: *the illustrious old man, visibly moved, took me by the arm and said: 'My dear boy, I have loved science so much all my life that this stirs my heart'.*

—Source: Patrice Debré, Louis Pasteur (p.48)

Pasteur's discovery was published to great acclaim in 1848, just before his 26th birthday.

Pasteur found that every active and naturally occurring biological molecule has a definite form, which can be symmetrical, but most are chiral—either right- or left-handed. He showed that the taste of food is related to molecular asymmetry. One form can taste sour or sweet, while the identical mirror image molecule is tasteless. One right-handed molecule found in the rind of citrus fruits has a strong smell of oranges but its mirror image, whilst chemically identical, has a piney or turpentine-like odour.

This "dissymmetrical force", as Pasteur called it, operates only in living organisms and is the only well-marked line between the chemistry of dead and living matter.

Whilst he could not have known at the time what we know today, the genius Pasteur was already imagining in the right direction. Twenty-two years after his original discovery, in a letter to Jules Raulin, a French chemist and biologist who was a close associate, Pasteur reflected:

You know that I believe that there is a cosmic dissymmetric influence which presides constantly and naturally over the molecular organization of principles immediately essential to life; and that, in consequence of this, the species of the three kingdoms, by their structure, by their form, by the disposition of their tissues, have a definite relation to the movements of the universe. For many of those species, if not for all, the Sun is the primum movens *of nutrition; but I believe in another influence which would affect the whole organization [geometry], for it would be the cause of the molecular dissymmetry proper to the chemical components of life. I want to be able by experiment to grasp a few indications as to the nature of this great cosmic dissymmetrical influence. It must, it may be electricity, magnetism…*

—René Vallery-Radot, Life of Pasteur (p.198)

In his last few experiments on Dissymmetry, Pasteur placed crystals and plants in powerful magnetic fields to observe if there were any transformations in their optical activity, structure, or synthesis characteristics. He grew plants under conditions where the light was reverse polarised through the use of quartz and mirrors to observe the results in geometric form. Unfortunately however, Pasteur did not get back to this crucial work until close to the end of his life. He was needed to solve many other pressing biological problems instead.

In 1854, at 31 years of age, Pasteur (with his wife and two children by this time), took up the position of Chairman of the Science Department, and Dean of the University at Lille, an important French industrial centre. Local workers and manufacturers would often sit in on Pasteur's weekly lecture on chemistry and its application to industry. A leading beetroot juice manufacturer came to Pasteur and asked for help in finding the cause of acidic and fetid juice. Pasteur immediately came to his aid, taking his microscope with him. This turned out to be the first of many forays into biology. He soon discovered that round globules grew and multiplied in the vat of juice and recognised this growing, dividing and growing again was a life process, and based on his previous work on tartaric acid and dissymmetry, he hypothesised this to be at the root of the fermentation process.

People had been fermenting wine and beer for thousands of years, but the knowledge of how it worked was not known. Most people believed it was a simple chemical action, and those who suggested that it might be due to a living force were ridiculed and seen as dangerous. Pasteur asked the question:

Where do they come from, these mysterious agents, so feeble in appearance yet so powerful in reality, which with minimal weight and insignificant external chemical characteristics possess exceptional energy?

—Source: Patrice Debré, Louis Pasteur (p.148)

Pasteur carried out rigorous experiments, which proved the crucial role of yeast, demonstrating that rather than a process of decomposition akin to death, fermentation was actually a life process, where yeast converted sugar into alcohol, CO2 and water in order to release energy to fuel its own cellular activity and reproduction. He referred to fermentation as "life without oxygen." He believed this was the mode of respiration and energy production in organisms prior to the emergence of photosynthesis and the release of free oxygen into the atmosphere of Earth. While yeast was responsible for the fermentation of sugar into alcohol in wine and beer, bacteria were responsible for converting alcohol to acetic acid in vinegar and lactose to lactic acid in yogurt. It was contaminating microbes that caused ferments to sour.

Pasteur's successes in treating the contamination and diseases of wine, milk, vinegar, and beer led him to the conclusion that "microbes" were also responsible for the many diseases afflicting animals and man. And this brought him directly into conflict with the proponents of the theory of "Spontaneous Generation"