Gérard Klein : BLACK MATTERs

Wave, Light, Chance: Images in a Quest for the Invisible

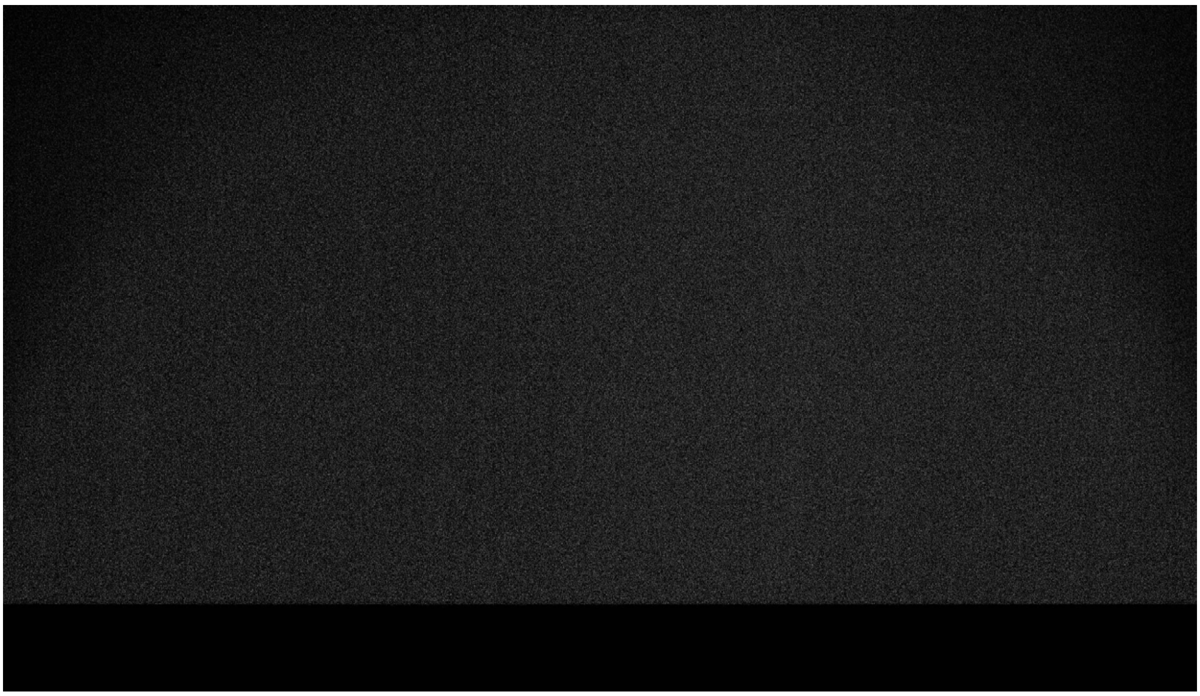
The immense stretch of violent, salted water was referred to as the bitter wave in ancient times…

Thales, the ancient Greek philosopher and mathematician, saw in water the primary element. This was a slightly exaggerated, according to Anaximander, his disciple and follower in Milet, who is regarded by many to be the first representative of scientific thought. While water is today regarded as a mere ash indispensable to life, waves still hold their ubiquitous dimension.

Several centuries later, photography—comprising electromagnetic waves, photons, particles, and the other face of light striking and activating complex salts—purports to represent reality as we see it or at least as we would see it if we were to stand in the place of the lens. Photography delivers faces, landscapes, streets, and images of peaceful life, or of wars and accidents; altogether, it delivers reflections of the surface of things.

Stationed at the edge of the earth, at the farthest tip of Brittany, Tom Fecht makes portraits of the ocean, an ocean we could never see with our bare eyes, as he captures it in a thousandth of a second through an aperture reduced to a pinpoint. The beholder is mesmerized by the precision of detail, the depth of field, and the print size (180 x 295 cm) of the works comprising his series *Eclipse*: "The sea is your mirror; you contemplate your soul." And because the sea never displays the same face twice, every print of this series is unique.

The meditative state to which Tom Fecht's photographs of the ocean or the sky invite us fosters yet another reflection. It leads to the other side of the mirror in search of the very different, even incompatible, representations of the world suggested by both classical and quantum physics.



Tom Fecht *Incertitude # 64001, 2016 (Detail)*
Unique gelatin silver Baryta print 125 x 210 cm. Ultrasec

Gravity, or better said, the force of gravitation, forms and shapes the waves. It also stirs up the winds that heave the swell of the sea. It governs the tides that let the surf break against or spread along the beaches. It is undoubtedly the force best defined by classical physics which proves that it extends into the farthest confines of the universe: at least in theory, the movement of the most distant star turns, admittedly unnoticeable, the contour of every wave that Tom Fecht captures with his lens in *Gravity Fields*. Relying on the works of Galileo and Kepler, Hooke and Halley, Isaac Newton provides an excellent evaluation of the attraction of the universe, published in 1687, in which he indicates that this force is proportionately equivalent to the mass that produces it and that it decreases when raised to the power of two in proportion to the distance from the gravitational center of the mass. The equation governs not only the fall of apples, but also the orbit of stars. For the purpose of establishing it, Newton conceives a space and an absolute time and takes into consideration that it is transmitted immediately, thus at an infinite speed, into the void regarded by Newton himself as an absurdity so great that, as he writes to a friend, no sensible mind would accept it. In 1915, Albert Einstein will resolve the question and find an answer to Newton's qualms with his theory of general relativity, incorporating gravitation to a deformation of space-time as a result of the masses. In more than one way, classical physics is thus brought to an end. It is the universe as a whole that is stirred by gravitational waves as predicted by the theory, but not until September 14, 2015, will it be observed for the first time, exactly one hundred years after the theory was made public that conjured up the possibility.

The quasi-metaphysical and ultimately insoluble question that is prompted by photography is to decide what should be documented. It is not that the image mostly represents what it shows. News, wars, marriages, births, spectacular landscapes, celebrities, accidents, nudes, chance oddities, or overly image-like images generally relate to an author's intention or to a possible appeal to the beholder—fear or emotion, awe or distraction, approval or rejection—possibly even encouraging artificial setups behind the spontaneous mask of the instantaneous that a somewhat naive critic would likely rule out as anecdotal.

Nothing of the like with Tom Fecht. He confronts us with a form of the real as if he were absent from it. The real should not be deciphered through our pitiful emotions, but we should attempt to understand it instead.

The ocean waves that Tom Fecht loves photographing in the rare moonlight and even dimmer starlight are a matter for classical physics, as waves are indeed a matter of surface— superficial, in other words. Yet they bring us back to the depths of their element and to ours, encouraging food for thought. We can only imperfectly decipher their writing. An old, science-savvy friend of mine used to say that if we knew how to analyze one single wave, or at least the waves of an ocean resulting from all the forces at play over that stretch of water, then we would be able to trace the bow of Cleopatra's ship in Actium. Or any other.

From the tip of the Finistère, where the photographer sets up his cameras for endless nights of work, Tom Fecht might possibly succeed in reading Christopher Columbus's transatlantic journey, which was only made possible as a consequence of gross miscalculations relating to the actual size of our planet. These planet's curves are imperceptibly illustrated in Tom Fecht's horizons. It is a simple matter of the principle of Fourier transform (FT). But waves are extremely complex. After attempts by Airy, Stokes and others , we still do not know how to fully break them up. Waves have a random dimension, and only statistical approximations can be made of them.

Ocean waves also carry a fractal dimension under certain constraints: Tom Fecht's photographs distinctively show the greater wave jolted by wavelets, themselves quivering from smaller vibrations. Any reflection about waves brings us to consider both the power and the limits of classical physics; it describes a simplified world and yet stumbles over the nearly infinite multiplication of a detail.

The ocean-wave model provided physics with an extremely powerful tool: the concept of the wave. There is nothing intuitive about the notion of the wave, except in the case of ocean waves. Pythagoras's disciples nonetheless drew a conclusion for the sound of an instrument, which they zealously expanded to the whole universe. In many ways, they were anticipating modern, classical, and quantum physics. Classical physics explores sound, light, material vibrations, and hydrodynamic whirlwinds through the concept of the wave.

Quantum physics drew some principles from the real that violate classical physics and even often challenge common sense—discontinuity, for example, or uncertainty, complementarity, and non-locality. Waves are essential to quantum physics. The latter first considers that the real, starting with energy, is fundamentally composed of small packets, or quanta, and specifically of wave packets. The real ignores continuity.

As a result of discontinuity and of its undulatory aspect, it then shows, for instance, that it is impossible to measure both the speed (physicists use the terms "momentum" or quantity of movement) and position of a particle or of a wave packet with an arbitrary or unlimited precision. The more one aspect is precisely measured, the more the other's measurement will be uncertain, the relation between both values being determined by Planck's constant.

Quantum physics sees two states—the particle, in principle locally or even punctually defined, and the wave, expanding in space—as complementary and alternatively revealed through various different experimentations. Tom Fecht's favorite tool, the photon, is not only a particle in Newton's terms or a wave as demonstrated by Young: it is alternatively one or the other, according to the perspective from which it is considered. The property of complementarity has been extended to any presumed particle and even to any object. These "wavelets" do not have any definite position, but only the probability of a position described by a wave. Thus, according to quantum physics, an object has no definite position—only a probability to be at a given position as revealed by measurement, thus excluding any other possibility. While significant on a microscopic scale, these effects remain negligible on ours.

Non-locality is the most recently established effect in quantum physics and the most striking, too: when two quantum objects have interacted at any moment in the past, they remain conflated in one, interlocked. Even when they have drifted very far apart, they "seem" to instantly communicate when one of their properties is measured. The measurement of a property for one of the objects instantly creates an immediately acknowledgeable value of that same property for the other object. This does not violate relativity, according to which nothing travels faster than light, since no energy and no information can be transferred that way. The objects thus interlocked, inseparable albeit spatially distant, have no particular properties of their own; a system that may be at once positive and negative on a single criterion. If the measurement of one object gives a positive value, the other instantaneously becomes negative—as if it had received the information by common sense.

Another consequence of quantum physics is the energy of the void, a very different void than in classical physics. According to the latter, there would, by definition, be nothing, meaning that a region in space can carry a set energetic value, and it would be null in this particular instance. This is incompatible with quantum uncertainty, for which each region carries a form of non-null value: pairs of virtual particles appear only to instantly vanish, leaving too little time to violate the general law of energy conservation. Not seen, not caught. Even if these particles are unobservable, the Casimir effect establishes their existence. These fluctuations in the void evoke a form of "quantum lapping."

[1] Cf. https://fr.wikipedia.org/wiki/Vague

The wave of position probability has a curious effect: when a particle meets a wall (a barrier of potential) and if it is insufficiently charged in energy to cross that wall, then there is a small, yet not null probability that it will be found on the other side; this is the "tunnel" effect used in many techniques such as microscopy.

Since calculations cannot predict the features of an object prior to measurement and only the probabilities that they may hold such value, the quantum approach ultimately introduces true chance. It is as if the value informed by measurement were to be drawn out of all the possibilities suggested by the wave of probability. Chance is not a form of ignorance such as that which prevents us from knowing which side of a coin tossed in the air will face up, while its trajectory is entirely determined by the way it is tossed and the influences it will meet on its way, like a blow of air. For some, chance—which is fundamental, a quality of the real—establishes the sentiment of our free will.

What meaning can these reminders bear when reading Tom Fecht's photographs?
These prints of the ocean refer to classical physics, even if they suggest some of its limits. Ocean waves are human-sized objects, macroscopic, even if their multiplicity, variability, and complexity cannot be fully described. Better even, their movement is congealed as if the image represented a slice of relativity's space-time block. This leads us to question the nature of time. And what if it was but a dimension linking the successive stages of the universe according to an absolute determinism, yet excluding any simultaneity and any possibility of freedom?
With its slightly slanted horizon and asymmetry resulting from the direction of light, Fecht's *Eclipse # 7953* thus seems to have congealed waves borne by a current that shapes them into near-sinusoidal traces. The dark sky in *Eclipse # 8078* evokes the spiral of some galaxy suddenly jammed along its central axis.

For a nonscientific mind somewhat acquainted with quantum physics, however, other images from the *Incertitudes* series are even more enigmatic in their sublime austerity. A dark sky colonized by white dots overlook a uniform black stretch of sea. No waves here and no reflection either. Along with an absence of color, already reluctant in the *Eclipse* series, the minimalism of innumerable dots suggest abstraction. Indeed, the kind of abstraction that arouses the imagination and refers to a physical reality only made accessible to us by means of technical devices.
We know that these views result from long photographic exposures that can last up to three hours and that the sensitive surface is outdated, thus no longer offering the full properties of a normal film. We also assume that these photographs have been taken on completely black, moonless nights, and probably under covered skies, as is so often the case in Brittany; a sky like a curtain, blocking any light from space, at least to the human eye.

Let me guess.

Why is the lower part of the image—in other words, the sea—seemingly uniformly dark, as if no light had reached it? Most likely because too little of the rare light was reflected by the ocean to substantially expose the reluctant film. The water probably absorbed the most energetic photons, but the ones that could be reflected were not strong enough to be revealed in the view. Ocean waves cannot appear in long pauses; their contradicting movements are annulled on average, and the ocean turns into an obscure mirror. They are annihilated in their successive superimpositions.

The sky is more mysterious. The white dots are not stars, and no constellations are discernible. Their distribution seems purely random, and there are no large gaps of luminosity as is the case in a clear night sky. The circular movement of the stars, approximately around the polar star, resulting from Earth's rotation and usually tracing its line in any long exposure, is not detectible either. The eye might be led to believe that it is vaguely seeing alveolar structures, but the brain is being trumped through a phenomenon referred to as pareidolia.

These dots do not represent stars. Perhaps some radiance from the depths of the universe… Photochromic substances are usually only sensitive to light. So this is indeed light, even if only due perhaps to some cosmic emission that tends to escape our vision. The light from the stars comes from far away and, thus, from a long time ago. Some of the celestial bodies that were emitting light years, centuries, even millions or billions of years ago have faded, but not all of them. It is a fossil kind of light in a way, though for each of these photons, according to relativity, no time has spanned since it was emitted. Old for us, they are newborn from their perspective. The apparently random distribution of the dots possibly stems in part from the obstacles, the clouds, that photons meet as they fall from the sky; but they are most likely due to the film's strongly attenuated, now stochastic sensitivity. At different moments, the most energetic photons have excited, and exhausted, the randomly distributed zones still active on the sensitive surface. The aging of the film generated chance, which in turn reflected quantum chance, or true chance, on the side of the photons that have reached Earth and of the still active molecules.

Clearly, this enigma is the result of the activation of photochromic components by photons. Photochromism comes from a modification in the electronic configuration of the substance being excited. This generates a possibly reversible modification of the absorption spectrum within the visible. Tom Fecht prepared an installation: the result is observable, but we ignore the details of the intermediate stages, as does he. This hints at quantum mechanics in which the evolution between the preparation space (the system from which a particle is emitted) and the space of measurement, when properly described through Schrödinger's equation, does not convey the result of the measurement.

Temperature is another physical variable at work in these images, as the sensitivity of the outdated large-format films (8 x 10 in.) is greatly dampened. Heating the film, in reasonable yet subtle proportions to be determined, can improve this. Thus, beyond the regular parameters such as aperture and exposure, Tom Fecht must also master the temperature of the sensitive surface during exposure and in the dark room where it will be processed. Uncertainty, which is not quantum here, is warranted. The photographer's experience can never fully guarantee the result. Physical conditions and the local state of the universe also express themselves in these instances.

However, reality is substantially different from what I may have suggested and from what I had naively imagined before even knowing about it.

Each of these *Incertitudes*, in spite of the size of the print (125 x 210 cm), corresponds to a minute detail on the negative, on a scale of one square centimeter. At that level, the dark stripe in the lower part shows the blurry line of the tide swinging endlessly back and forth. The stars are absent from the image, as they stand way above the white dotted space. A space confined between both sea and stars, haunted only by the activation of tiny, still-sensitive photochromic crystals distributed by chance on the outdated film. We are in the realm of the near microscopic, on the verge of the quantum world. No one can tell where these photons came from or why they have randomly revived the molecules. These enigmatic firmaments reflect our world's fundamental chance—or quantum chance.

The apparent curve of the firmament does not correspond to any cosmic reality. It is due to vignetting, a loss of light in the angles due less to the features of the highest-quality photographic lens, a loss possibly amplified by the extended exposure than to imperfections in the optical device of projection onto the baryta paper during the printing process. Here, the viewer can perceive a macroscopic physical object, the actual equipment. Physicists, particularly those who deal with the quantum world, know about these interactions between a microscopic object, never directly observable, and their macroscopic instruments, allowing them to observe them at our own scale.

Each of these photographs—whose print, may it be reminded here, is unique—is different from the next, even if it may seem otherwise. What happens when vagabond photons interact with photochromic particles is a result of the quantum. As the mathematician Alain Connes writes: "It is very hard to acknowledge the fact that, at the microscopic, quantum level, some phenomena cannot be reproduced. However, it is a fact. Its philosophical impact is difficult to grasp. Here, it is difficult to acknowledge the fact that nature, at the atomic level, is unpredictable—even if the physico-chemical 'reality' is deceptively subtler."

The white dots in *Silver Firmaments*, where no constellation or movement can be perceived, send us back to the most fundamental indecision revealed by the boldest theory of our times.
From the perspective of quantum physics, the universe is a prodigiously complex wave that might be described by a generalization of Schrödinger's equation. The wave universe is mostly cosmic—as in Tom's Fechts photographs, where the lights falling from the sky, long after leaving their celestial bodies (some of which have since probably faded out) come to excite the photochromic surface after an indescribable journey. Quantum physics sheds some light on the matter. It suggests that everything is a wave, not only a wave agitating a medium, but a wave of probability, a positional wave, and an altogether existential wave whose perpetual oscillation prevents us from ever reaching to the bottom of things.

In a conversation with Thierry Magnin at the Collège des Bernardins, Paris, on September 30, 2009, the recently deceased physicist Bernard d'Espagnat said: "I thus feel […] that our knowledge is not about 'the real,' the bottom of things, but only about empirical reality; it is about the image of reality that the human mind, considering its finite structure and capacities, is led to constitute itself of reality as such. And considering the global nature of things, I feel that we should even abandon the idea that objects, be they elementary or composed, exist by themselves in every instance, each in a given location. It is truer to say that if we see them in such a way, it is because the structure of our senses and of our mind leads us to see them that way."

Bernard d'Espagant later added: "I would say that while science is the absolute queen when it comes to accessing empirical reality, it is however ill adapted when dealing with the 'bottom of things.' There, at least, an emotion that might be artistic, for example, can actually be on a par with it, since both deliver but a pale yet precious glimmer across a domain, exposing only a glimpse of it."

The approach chosen by Tom Fecht is one of the real, of the being, and it is to a large extent drastically different from that of contemporary art—a medium that has abandoned this ambition and is based on the idea of a game, the rules of which would be established by the artist … rules that should preferably be original or *avant-gardist* in nature. For over a century, literature has already somewhat forsaken the quest for meaning, rejecting it as overly metaphysical and thus vain, favoring instead more playful combinations whose effects wither away after an initial surprise.

As such, the work of Tom Fecht meets that of his compatriot and near contemporary, Anselm Kiefer (born in 1945), or of Paul Celan (1920–1970) in his effort to experience the inexpressible through the atomism of words. After the demise of totalitarian rules—negations of all sense of meaning or any hope for it on behalf of humans—they have had to recover the path to a possible innocence, on their own terms, with or without any illusions.

For us, of course, the real, the being, will remain forever inaccessible or concealed according to the words of Bernard d'Espagnat. But it is the tension toward that being, that real, the unyielding and yet hopeful effort to move closer to the "bottom of things," the absent object, that ultimately supports the arts and the sciences—and, sometimes, their encounter.

Where we believe we cannot fathom anything, we sometimes reach into something of the real, which can only assert with certainty what it is not. Black is not the void. *Black matters*.

[2] Alain Connes, Matière à pensée, entretiens avec Jean-Pierre Changeux (Paris: Editions Odile Jacob, 1989)
[3] Académie des Sciences morales et politiques. Collège des Bernardins, Paris, le 30 septembre 2009. Physique et Réalité, Interview de Bernard d'Espagnat par Thierry Magnin.
https://www.asmp.fr/fiches_academiciens/textacad/espagnat/09-30-30_InterviewBernardin.pdf

Photo: Tom Fecht

Gérard Klein, Paris 2016

About the author:
Writer, essayist, economist, and editor, Gérard Klein has an avid interest in the arts and sciences, and enjoys thinking about the future. He is the founder and editor of the literary collection *Ailleurs et demain*, a symbol of quality science fiction in France. He has published close to 15 books translated into a dozen languages and is the recipient of several prizes such as the Pilgrim Award from the Science Fiction Research Association for his lifetime achievements. Most recently he published *Heurs et malheurs de la physique quantique* (Triumphs and Failures of Quantum Physics) in collaboration with Jean-Pierre Pharabod at Édition Odile Jacob, Paris 2017.

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