Notes to *The Birth of Physics*

> "To grasp more firmly the restless movement of all the particles of matter, remember that the whole universe has no bottom and thus no place where the ultimate particles could settle… the ultimate particles are allowed no rest anywhere in the unfathomable void; rather they are harried by incessant and various movement…" - Lucretius, On the Nature of Things (Book II, 93)

Protocol

Declination in a Laminar Flow

Serres begins the first section of *The Birth of Physics* by showing how the clinamen (atomic swerve) has been represented as a weakness of atomic theory, as a prescientific absurdity. Why has it been able to appear this way? First, because declination is a physical absurdity (since experimentation cannot reveal its existence); second, it is a mechanical absurdity (since it is contrary to the principle of inertia and would result in perpetual motion); and finally, it is a logical absurdity (since it is introduced without justification, as being the cause of itself before being the cause of all things.) Serres writes: "The thing is so absurd and so far from our experience that the physicalist minimizes it, as if to hide it." (4)

Since the theory of the clinamen is no concern of science, Serres argues it has instead found a haven in subjectivity, "moving from the world to the soul, from physics to metaphysics," (3) from a theory of inertial disruption of primary elements to the cause of the free movement of living beings. Serres presents this as the scenario for how we move from a 'secret decision' of atoms to move this way or that in a void, to the final 'secret' of the decision in a subject. In other words: from declination to inclination. Notice that Lucretius points towards this will torn from destiny:

> "If there is no atomic swerve to initiate movement that can annul the decrees of destiny and prevent the existence of an endless chain of causation, what is the source of this free will possessed by living creatures all over the earth?"
> - Lucretius, (II: 256)

In short, Serres argues it be wrong to read "On the Nature of Things" as a treatise on physics. Rather, we must read it as humanists or philologians.

So the clinamen is an infinitely small angular deviation produced in a laminar flow of energy and heat. There are two interrelated ideas here: on the one hand, the concept of the potential and actual infinitely small (which of course relates intimately to differential geometry,) and on the other, the idea of laminar flow, an ideal of truly 'parallel' movements of atoms through space. Clearly they are both in a certain sense theoretical; the infinitely small by definition abjures inspection or division; and in the real world it is very unlikely for local flows to remain parallel, they always become turbulent. Hence Serres' fundamental question in this work: "How does turbulence appear in a laminar flow? …The fall of atoms in an ideal laminar cataract, what are the conditions under which it enters into concrete experience, that of vortical flow?" (6)

Turbluence

Alright, so how do vortexes appear in the laminar cascade? Well, precisely by the swerving of atoms in their flow and fall: "the clinamen is the smallest imaginable condition for the original formation of turbulence." (6) Cicero writes atomorum turbulenta concursio, atoms meet in and by turbulence. This theory is found in Lucretius: but again, what does this have to do with physical science? The incidence or inception of turbulence is indefinite and undetermined. This argument against declination is silent about its hypotheses or models, much less its descriptions; yet, Serres notes, it does say something about its own ideal of science, that "for it to carry weight, knowledge should have nothing to say about chance distribution." (6)

But Serres loses no time in reminding us that Lucretius is faithful to the phenomena themselves, i.e., that "turbulence appears stochastically in laminar flow." (6) In other words, we can construct a model apart from the general framework of modern solid mechanics, even though the clinamen appears only by chance, and we do not know why. For Lucretius and Serres, vortex in a fluid medium is a new bearing, and in fact already at the very beginning of the world.

So Serres believes we can compose a working hypothesis and experimental protocol. In order to understand the atomist project, in order to comprehend turbulence, we have to give up our technical speciality in solidity, the heart of our modern theoretical foundations. What is theoretically difficult is not declination, but understanding declination within the framework of a non-fluid mechanics. For "in relation to theory, the appearance of concrete experience is contemporaneous with that of vortices. Declination is their beginning. Nothing is absurd here, everything is exact, precise, and even necessary." (7)

Thus can a new science be outlined: we outline a sheaf of parallels, and at some point in the cataract or flow, a small angle is marked, from which a spiral evolves. Atoms which were once separate can now meet, in and by turbulence. Lucretius is even more precise than this, for his text opens the minimal way onto differential calculation itself, to an ideal of a great number; a whole corpus is implied by this 'simple' model, one which Serres believes is provided by Archimedes. As we and Serres proceed, the theoretical impulse that guides us is the one guiding Lucretius as well: no flow remains parallel for long; turbulence quickly appears.

Mathematics

An Analysis of the Hydraulic Model

We return briefly to the connection between declination and inclination. A classical description of the will or uncertainty often appeals to an image of a balance or a pendulum. A decision or determination or unrest is here a small or even the smallest change in the balance, a tiny shift of tension or correspondence. An infinitesimal angle of the beam: not declination but inclination; it is this sort of machine which supplies the classical model, and of course it is a poor model. The model is poor because it is static. Serres writes these models are 'theorized theory,' that these machines are statues, field magnets, the immobile part of an electric motor. Thus we have a psychology which is actually a mechanics: "You forget about geometry and think you're talking about a subject. But in fact you're only talking about machines." (9) This forgetting goes on a long time, until the angle of the atom is nothing

but the freedom of the subject; then, consequently, the real world becomes muffled, indistinct, obscure, "like a dream of the soul." This is why we must return to the Greeks.

Serres embarks upon a history of the angle. He observes that the classical method of the Greeks is the measurement of segments. He notes that for them the triangle is really a trilateral. We have to await the development of trigonometry for the measurement of angles to be combined with other elements. Thus Serres argues that angles "resist effort at quantification," that they tend to remain shapes or corners; angles are like qualities. They are less easily abstracted and related to numbers than a line or a segment.

"Between two straight lines or two line segments, this minimal angle makes no sense." (10) Rectilinear solids needs only general, ordinary mathematics; but for the square of curved elements, we need a new proto-calculus. The theory of irrational numbers as a springboard to atomism. At any rate, atomism answers a question about divisibility and indivisibility. That is, the last division always recedes beyond our reach. Democritus provided solutions for the volume of a cylinder and indeed any solid of revolution; this was probably accomplished by integration. Differential division implies atomism. "Democritus is the Pythagoras on the side of things, of the irrational and of the indifferentiable." (10) Things for Democritus are a crowd of "subliminal" atoms; we don't yet have a sum of infinitesimals, but a very large number of subdivisions: "In this way, one crosses the threshold of perception at the same time as that of operation." (10)

What happens in the closest proximity of the curve to its tangent? Serres contrasts the contingency of classical metaphysicians with the 'angle of continency' of classical mathematicians. "Physics is an affair of angles." (10) The atom could only have ben born by the treatment of curved elements, amidst the irrational and differential; or either by the infinitely divisible stopped short arbitrarily. But it also requires a minimal or atomic angle, what for so long appeared to be such a monstrously absurd idea. The angle of contingency is minimal, indivisible; it is "more atomic, so to speak, than the atom." (11) No atomism without curved elements, no curve without tangents or minimal angles. Therefore, no atomism without declination, the full schema of an inflected path. Back to inclination: we have forgotten geometry, and see subjective freedom only as contingency, turbulence without angularity. But even in Euclid, the angle is clisis, bending or inclination.

So Serres shows us the link Democritus provides between atoms, angles and curves. He pauses to recall the model developed earlier: "First a sheaf of parallels, where a laminar flow slips by. At some point, that is to say by chance, a deviation, a very small angle is produced. A vortex forms at once from this point on." (11) He then gives us a fairly rigorous subdivision of his model (as well as the necessary tools for mathematizing it) as follows:

1. A large atomic population (a mathematical or arithmetic theory of elements)
2. A tangent to a curve, an angle of contingency (a geometrical theory of the tangent)
3. A solid angle, a cone (a geometry of forms of revolution)
4. A curved vorticial line (a theory of spirals)
5. Infinitely small elements (an infinitesimal calculus)
6. Balance and deviations (a mechanics of equilibrium)
7. Flows, a fluid medium (a hydrostatics)

Archimedes, of course, is the man who will fill the requisite conditions. Serres first proceeds to demonstrate the general unity of Archimedes' whole work. Then he must show that atomist physics is "not non-mathematical, as was believed," but rather is given expression "analogically" through the mathematic models of Archimedes. Consequently, "the Greeks did not conceive of mathematical physics in the same way as we have done since the Renaissance." We mix experiments with equations, accompany protocol with formalism and metrics; without this "continual proximity," we would have no experimentation, nor even law itself. Serres argues the Greeks would have been "strongly repulsed" by this kind of mixed model. For them there was no unitary mathematical physics, as we have; theirs was double, both rigorous formal systems and dissertations upon nature. We do not often dare to assert the two are isomorphic, for "we would need a local and subtle blend of the two and we have only scattered monuments." Serres concedes that it is strange, but that we have to try and understand that the Greeks had a mathematical physics. We have to learn to see it.

Archimedes' Work

Archimedes' *The Sand-Reckoner* is an expository research into the size of the Universe (in modern terms his final estimate was around 2 light years.) For Serres' purposes, we are interested in the fact that the work concerns numeration, series and the theory of increase; it represents an early positional numbering system for manipulating very large numbers. He compares Archimedes to Leibniz: in his effort to measure the number of grains of sand which would fit into the universe, he is in some way attempting to make a certain model of reality rational, by means of arithmetic. Both are among the thinkers of the infinitesimal; like Leibniz with the monad and Democritus with the atom, Archimedes ends up arriving at indivisibles (grains of sand.) A dream of constituting the universe by these simple means, as the circles and spheres of geometry; this is why he must introduce scales of order. "The Sand-Reckoner builds a world and then places all these means at the service of a model." (14) The schema is plainly atomistic: the universal is filled with grains and absences, atoms and voids. Things are homogenous, the model is closed; but don't forget Archimedes was a thinker of the maximum and minimum. The model is naive, the limit, even the infinite, in Gauss' sense — mathematically finite and physically infinite. The strategy (progressive orders) suggests we may as well never stop: and again, this is how we classify infinities (large numbers and ordered progressions.)

Serres finds the entire atomistic model present in Archimede's word tomos, or the frustrum of a cylinder, divided by parallel planes not perpendicular to the axis of revolution. "The turbo delimited by two inclined planes is thus called tomos." (15) Archimedes provides an arithmetic of sand, an infinitesimal calculus and a plane geometry of spirals. Even a statics of levers and a hydraulics of floating volumes. Serres argues the work is a conceptual whole: "It is a matter of grains and wholes, and of counting them…Of the formation of stable spirals and spiralling vortices. Of the immersion of this mechanical, geometrically constructed model into liquids." (15) But why spirals? Because a point moves on a line uniformly, "like an atom in the void on a gravitational geodesic." (16) The line turns; points run on from one another without being able to catch up; they are arranged on parallel geodesic lines; a vortex conjoins the atoms, as the spiral links the points; the turning brings together atoms and points alike. In global processes as well as in singular decisive points, the minimal angle of tangency or clinamen lies between the geodesic of the fall and the beginning of the spiral.

Serres notes that he thought he had established in in earlier work that the general method of division into dichotomies found in Plato's Republic is formed as a spiral, a curved line defined by diagonals and

successive squares, but beginning at a common point, giving coherence to the dialogue, to the "cosmology of two times." The relation between the atom and the vortex exists clearly in Epicurus, but it is there as an idea, in its "abstract formality," in Plato. Archimedes, like Pasteur, really only had one idea: that of deviation and excess.

Archimedes, or the concept of deviation

Mathematics models liquids for the first time in history, and a world which deviates from equilibrium. Equilibrium is a special case of proportion, or angles; statics is a discourse on inequality. Statics cancels itself out as it grows, since it describes the deviation, measures it, draws it back to zero. Thus there is an unexpected coherence in Archimedes. The moderns are outraged at the impropriety of using a lever to demonstrate a parabolic segment; it mixes mechanics with geometry. "On the contrary," Serres writes, "it is superior as a system and testifies in favor of the unity of the method and the coherence of a world. For it is a matter, in both cases, of making a perceived difference vanish… Without this fundamental step, statics would have yet to be born." (21)

Serres argues that if we had only the principle of identity, we would be "mute, motionless, passive," and nothing new could ever exist for us. (21) No world: the principle of reason is simply that there is something rather than nothing. It follows the world is present; but this principle is never explained except in terms of its substantives (the void, the thing, being and nothingness.) Exists rather than: it is to be in deviation from equilibrium, and is "almost a pleonasm, since existence denotes a stability, plus a deviation from the fixed position." (21) The principle of reason is a theory of statics: everything, excepting nothing/identity, is deviation from equilibrium. Against Platonism: the principle of sufficient reason is the source of existence, of speech, of calculation and the efficacious act. And this is the locus of the first atomist discourse. "The beam no longer has a balance point." (22) Deviations appear, stochastically, or differential angles of inclination. Vortices, spirals, all models formed temporarily out of equilibrium, all brought back to zero by ruin and death. Atoms, Serres explains, are letters, combined into sentences, joined to form volumes. If we can speak, it is because of this deviation. Archimedes "brings rigor" to the principle of sufficient reason; Lucretius "naturalizes" it (22). "All is, all is thought, spoken or worked, in and by the deviation from equilibrium. Here, once again, is the nature of things. And great Pan is reborn." (22)

--Joe Weissman

Science and Parasites: Michel Serres and the Unification of Human and Natural Sciences

> *Theorem: the history of science obeys the law of diminishing returns. The first attack on the narcissism of science…*
> *Second: if we examine the set made of the problem and of the actions that transform it, there is no doubt that it is, at the beginning, more complex than the thing itself or the process. Clearer perhaps, yet more complicated. The question can then be reexamined in order to try to illuminate this new complexity and maybe, to transform it. Thus we form a set: the chain seems unending. The strategies of intervention, the interruption of the process or of the thing, observation that seeks to clarify, photon bombardment, the inseparable association of the knowers and the known–all make complexity increase, the price of which increases astronomically. A new obscurity accumulates in unexpected locations, spots that had tended towards clarity; we want to dislodge it but can only do so at ever-increasing prices and at the price of a new obscurity, blacker yet, with a deeper, darker shadow. Chase the parasite–he comes galloping back, accompanied, just like the demons of an exorcism, with a thousand like him, but more ferocious, hungrier, all bellowing, roaring, clamoring. Have I described the elementary link of a system of knowledge or its pathology? I do not know. Anyway, it makes work, gives sustenance. One parasite drives out another. The second attack on the narcissism of scientists. The shadow brought by knowledge increases by one order of magnitude at every reflection. Can we henceforth do without an epistemology of the parasite?*

Michel Serres, The Parasite 17

Michel Serres' *The Parasite* should be read as an extended critique of media, an impassioned appeal against the all-too-hastily narrowing spaces of historical and scientific explanation and discovery. Instead of confining knowledge within the human or physical sciences we should rather remember that knowledge of any kind irreversibly captures the world. Knowledge parasites real systems. Sometimes, it even begins to govern their evolution.

Serres claims that the parasite invents this very exchange of matter for logic, this mysterious bridge between the segmented sciences, this parasite which creates science and theory on the same day: "What would all knowledge be without this asymmetrical, crossed exchange? This irreversible capture." (P 210) The very same parasitic diagram is to be found in both observation and experiments, both human and physical sciences: they all presuppose an interception, they construct unidirectional flows, they support an asymmetrical balance of operations. There is a unity between the human and the physical sciences, not a convergence but precisely an isomorphic structure:

> *Very little literature strays far from science, and much brings us back to science. Very little science strays far from literature, and much brings us back to literature. Logic and anthropology are found in the same strait(s); subdetermination [hypocrisy, 'fuzzy' logic] has to to with all knowledge.* (The Parasite 215)

The parasite is transduction across separated disciplines, bodies, forces, systems. The structure of the interspace is segmented, modular densities broken apart by bits of noise. These interruptions, these knotted and transposed interfaces, turn out to be the noisy origin of information, the terrifying black

abyss of knowledge. Parasite: atom of relationality. Therefore it is not the interspace as such, but the traveller between these distant lands (brought close not by journey but by folding space.)

The traveller who interrupts the meal is invited to the meal immediately, he is asked to join in, to exchange a good tale for his gastronomic satisfaction. From matter to logic, food to words: from speaking to eating, to speaking of eating. Fables of interrupted meals abound in the pages of *The Parasite*: the point, I think, is to emphasize the parasites' role in this transformation, that they create exchanges of the material for the logical, and vice versa.
The parasite is the invention of this passage of transformation between "ontologically" distinct layers and the exchange between (and the noise in the signal, etc.) Serres calls it a semiconductor.

The parasites invent exchange, but a 'broken' logic of exchange, which Serres says we are always forgetting. Serres puts it simply: parasites don't barter, they exchange money. They interrupt a unary operation, they transveralize an energy flow (introduce a slanted dimension, spontaneously breaking symmetry.) How does a vital, living, material energy engage in becoming verbal, disordered and linguistic information? "The parasite is the location and the subject of the transformation. The collective, at the table, makes noise. The collective, finally, can be unanimous starting with this noise." (P 211)

This raises an interesting and complex political question about the role of 'parasites' in the exchanges between molar solidarity and molecular turbulence. Perhaps this is even a possible critique of Serres: Does the epistemological model presented here really have a clear symmetric functionality as a model for a political struggle/organization? I think he can legitimately make this claim. Parasites, one-way relationships, show up all over nature and society, they are a fair candidate for the foundation for a project of conceptual re-unification. The parasite represents not a broken symmetry but a higher symmetry, a fuzzy and noisy organization, a fractal or proto-biological symmetry.

The parasite is therefore an extremely well-chosen conceptual vehicle for his new philosophy of time and history. The question is the exhumation of various topological spaces of knowledge (currently divided between 'human' and 'natural') and power (divided too, but in a very different way,) an analysis of their populations of intensities and exchanges and disjunctions, and finally the transformation of these spaces of society and the spaces of the earth(s) by the interruption of 'power-' and 'knowledge-vectors,' atoms of information or knowledge, units of qualitative relationality. In short, parasites are really at work all the time in terms of knowledge and power, they are the 'truth' of knowledge (falsification) and power (dissent).

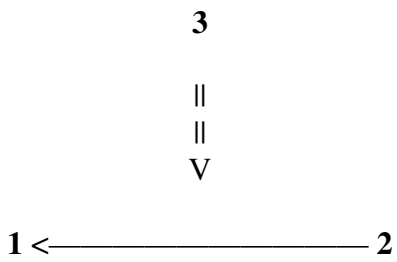
It is interesting that Serres remains ambivalent to the concept of the parasite through the course of its rigorous and powerful exposition, and though fascinated, he is more than a little shaken, repulsed, 'chased away' from himself. He does not know if he has stumbled upon a new atom, the essence of relation. Could Serres finally not stomach the parasite? Could he not abide this tormented and 'diagonal' logic of parasitic relations which obscures and confuses what belongs to the system, what makes the system up and what is against the system? For in closing *The Parasite*, he writes:

> *"Inundation of hell, swelling up of history. Here is the Devil then; no, no, I wasn't expecting him. He's come; the book is done, as if it were burnt. I didn't know that it was irreparably a book of Evil. The Evil of noise, of the song of hell, thundering; of hunger, illness, pain; dressed as animals and now undressed as a naked man; of Evil, quite simply. Meal, banquet, feast of the*

devil.
"It finally is separate from me. Thus the horrible insect slowly left my room, through the creaking door, one May morning, in Venice.

As Serres puts it, he doesn't know "whether the diagram of the rats is generative or corrupting." (16) It is a worthy question, one of the most interesting questions raised in *The Parasite*.

The Parasite is filled with detailed analyses of stories about interrupted meals, from the Symposium to La Fontaine's fables. The meal is the original relation. But it contains already a parasitic relation. The diagram is fractal. Serres diagrams its primitive cell this way:



The importance of the meal is the interchange between guest and host, which is transposed in Serres' text with the justaposition between the words 'guest' and 'host' in the French language, implying a disjunction across ontological layers. This original relation is interrupted by a third (and then a fourth, etc.) This invisible 'third' is the structural unity between theory and science:

> *It is raining; a passer-by comes in. Here is the interrupted meal once more. Stopped for only a moment, since the traveller is asked to join the diners. His host does not have to ask him twice. He accepts the invitation and sits down in front of his bowl. The host is the satyr, dining at home; he is the donor. He calls to the passer-by, saying to him, be our guest. The guest is the stranger, the interrupter, the one who receives the soup, agrees to the meal. The host, the guest: the same word; he gives and receives, offers and accepts, invites and is invited, master and paser-by… An invariable term through the transfer of the gift. It might be dangerous not to decide who is the host and who is the guest, who gives and who receives, who is the parasite and who is the table d'hote, who has the gift and who has the loss, and where hospitality begins with hospitality…*
> [Michel Serres, the Parasite 15-16]

The decision to be made is about the space of history, that is, the role of the third, the outsider, the other. How much (r)evolutionary capability are we going to assign to minor elements — to parasites, tiny fluctuations, minimal differences? The lineaments of an alternate history of science are palpable (see Notes on Birth of Physics.) But in short, Michel Serres introduces us to a new kind of time and history. Time is a dynamic and turbulent space, not a linear or repetitive chain. Serres proposes a multiplicity of different figures for time; we are to understand time topologically, diagrammatically, through methods both exact and inexact, in order to allow creative manipulation of the flow of time.

--Joe Weissman