information

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Essay

A Conjecture on the Nature of Information, with a "Simple" Example

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Abstract: Here, I take the position that information is a result of interactions between observers. In order to proceed with this, I construct a simple physical example, with forces standing in for observers. That example leads me to consider the relation between investigative work and energy constraints, which in turn leads toward a surprising suggestion concerning the most general motivation for work.

Keywords: Big Bang theory; informing; Newton's Second and Third Laws; Second Law of thermodynamics; work

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In this paper, I wish to characterize information as that which results from inquiry. I will simplify the concept by viewing information to be the effects of physical actions. The example used will have actions imposing forces that elicit pressures which can be relieved by transformations that may be interpreted as informative. In particular, I utilize Newton's Third Law of forces: pressure elicits an equal and opposite resistance. We might note as well, drag, the resistance to flow in fluid dynamics.

I propose that reactive resistance can be viewed as embodying information physically. This information reveals itself by way of a force contributing to the energy dissipation. Since the application of pressure will be matched equally by resistance, that initiating pressure is informationally necessary, indeed, crucial. That is, more generally—no information will appear without active searching. Thus, potential resistance, characteristic of objects and materials as revealed by actions upon them, represents information that could be uncovered by applied pressure. The force producing the pressure, then, elicits—but also determines something of—the information that will be uncovered by that action for the acting system by way of its establishing that pressure. So then, which comes first from the information perspective—potential resistance or pressure? Since information becomes manifest in the resistance as matched to the pressure, I suggest that pressure is informationally primary, in a strong sense creating, by way of eliciting, the information (this leads me to note in passing the "social construction of knowledge" perspective). Possible pressures are many and the responses to them may vary.

Then, as a way of clarifying this thought, we can examine a conceptually simplified example from the information perspective—the Big Bang theory (I believe that my simplified, Newtonian, characterization of the Big Bang here would be consistent with at least some of the versions of it that have been constructed so far)—in order to get a more definite feeling for this perspective in a physical setting. Regardless of what were the initial conditions, this theory represents an accelerating expansion of the universe, which must be responding to a pressure (the unknown origin and nature of which can be left aside here). Response to this pressure is made manifest by a symmetry breaking emergence of quarks and gluons, followed, upon continued pressure increase, by the formation of protons and neutrons which, following further pressure increases, materialize the emergence of the simpler molecules which, with continuing accelerating pressure increases, combine into the more complex molecular forms capable of forming early matter, which represent a drag upon the expansion of space. Thus, protons and neutrons here inform the emergence of early molecular species, which in turn inform the emergence of simple matter—all emergent from the continuing accelerated space expansion. The molecules and matter here are informational—as particular results of the accelerating pressure increases. The meaning of information in its most general sense lies in its consequences. In this example, physical reactions produce the informational results of a kind of primitive observation. (In semiotics, this would be taking a pansemiotic perspective, referring to the "physiosemiosis" of Deely [1]. Thus, the universe creates and deploys interpretants relating to its experience of continuing pressure acceleration.)

The theoretical principle here, viewed as an example of Newton's Third Law: primal pressure increase creates (in this case) step by step the resistance to that increasing pressure—matter. Then, matter cannot maintain an equilibrium distribution within accelerating space increase, and so, relative to that expansion, begins to form clumps, which begin to grow locally, and to continue clumping still further with increases in the pressure behind universal expansion. Thus, we find the emergence of gravitation—in effect, Big G—as the information (a kind of drag) elicited by the continuing expansion of space. In this sense, gravitation is seen to be a reflection of, or even an aspect of, accelerated space expansion. A consequence of this view is that G could not have been constant, even though today it may be changing very slowly compared with its early manifestation (importantly, taken as being constant allows G's use in cosmological calculations). So we see in this example how information devolves from increasing pressure. Once uncovered, the information does not, in principle, remain unchanged. Rather, in the form of new information, it needs to be recovered in an ever-evolving situation, always as a result of active probing (here, continued pressure increase).

Now we may note that in the above scenario, at the time when matter began to form into clumps, an important law of nature became salient—the Second Law of thermodynamics. Prior to this, it may reasonably be supposed that, e.g., protons and neutrons will have been diffusing in the direction of the growing "edge" of the universe, and this is easily assimilable to the Second Law, but for this law to have a macroscopic effect—from our perspective—that would occur only after matter made its appearance. In this context, the Second Law is revealed as a tendency of all material clumps to be at best metastable, and so all potential information is near the point of disintegration—unless maintained by activities that would preserve it. In the expanding universe, these would be provided by whatever is promoting the expansion itself. Activities of any kind are taxed by heat energy production by way of the generically poor energy efficiency of any work/pressure (I have suggested that this poor efficiency results from a general lack of particular information that would, in each case, be required to apply work pressures so as to match exactly each energy usage with the source of free energy, thus leveraging work in precisely fitting ways [2]). In the universe, we may surmise that the heat formed in this way gets cooled by the expansion itself. As with information-seeking work, information-preserving pressures would also produce heat energy from an (in this example, unknown) energy gradient funding the work.

Thus, the "destructive" aspect of the Second Law, as emergent information, is enabled by the ongoing expansion of the universe, which continually creates both metastable material clumps and simultaneously ever more low density space which invites their disintegration, but which can never be brought to energy density equilibrium because of the accelerating expansion of space. This situation leads me to suggest that the Second Law is also an important source of motivation for all pressure/work applications within the universe insofar as these applications must be funded upon the expenditure of energy. That is, the Second Law, as the requirement for heat energy production as a concomitant of (or tax upon) pressure applications, can be viewed as in a sense actually motivating those pressure applications in systems uncovering or preserving information—or, indeed, any pressure applications/work at all. In this way, we understand that information can be revealed only as a result of satisfying the universal tendency to disperse energy as widely as possible—in ways that have been demonstrated, for example, in the apparent universality of the Bejan constructal hypothesis (e.g., [3]).

Thus, within the story of the expansion of the Big Bang, I am proposing that the Second Law provides a portion of any motivation for the application of work, including those pressures that could lead to uncovering information as elicited resistance or drag. If this is the case, the meaning of the derived information should be modulated by a magnitude or intensity determined by how far the global system happens to be from thermodynamic equilibrium—the aspect of meaning involved here would be its urgency. That is, uncovering meanings in a situation very far from global equilibrium would tend to be/seem more urgent than similar works in situations much closer to global thermodynamic equilibrium. This would also require that the intensity of applied pressures would be conditioned by that distance from equilibrium as well. In this way, we see that thermodynamics encroaches upon kinetics, as we find in, for example, cases where there would be more than one pathway for energy flow in satisfying some work [4].

I add here a coda using Newton's Second Law of motion. As the Big Bang progresses, the accumulated mass keeps growing, and so, since the expansion is accelerated, the applied force behind it must be increasing as well. Then, while F = ma was meant to describe abstract magnitudes, I have above made a "realist" interpretation, with m representing actual universal material mass, as the carrier of information, and making it out that (an unknown) force/inquiry behind F/a has created this mass universally.

Finally, then, I conclude that physically "classical" information is, generally, a result of investigation, fulfilling an investigator's motivation. Acceleration could be said to be the face of physics for us here on Earth. Nothing happens here without acceleration. However, General Relativity has removed it from very large scale local actions by reinterpreting it as topography, while in Quantum Mechanics it is meaningless because interactive relations therein are instantaneous (at any distance). This situation can be represented as a compositional hierarchy [5]: [[[Quantum Mechanics immediacy] Classical inquiry] General Relativity transcendence]. Information (as discussed above) is Classical.

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