

BERGSON, PRIGOGINE AND THE REDISCOVERY OF TIME

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A central theme of Ilya Prigogine's works is the rediscovery of time through science. Such an acknowledgment of the significance of time by the scientific world is far from complete; since the establishment of Newtonian physics, the ubiquity of time has largely been ignored. When there have been scientific attempts to treat motion, time has entered the dynamical description "only in a quite restricted way, in a sense that these equations are invariant with respect to time inversion, $t \rightarrow -t$ " (BB xi). Neither classical nor quantum dynamics suggests that time should be anything like the temporality common to our experience. An unwavering faith in science alone has led many to dismiss both temporal irreversibility and temporal "flow" as subjective, psychological peculiarities. Prigogine's works may be seen as attempts to counter this trend.

Prigogine recognizes a similarity between his thesis that science has traditionally ignored the significance of time and some of the conclusions of the philosopher Henri Bergson. A century ago Bergson had argued that genuine time eludes scientific treatment. According to Bergson, the sciences are so structured that they must ignore all of the uniquely temporal characteristics of our experience; we should not expect the sciences to provide us with knowledge of time.

While Prigogine shares Bergson's dissatisfaction with this limitation of *classical* science, he disagrees with Bergson's suggestion that the physical sciences are by their methodological characteristics unable to ever provide an adequate account of time. Prigogine derives his evidence for the significance of time from comparatively recent work in chemistry and thermodynamics. Since he finds the reasons for rediscovering the significance of time within science, he dismisses Bergson's view of the necessary limitations of scientific inquiry -- Bergson was correct in recognizing the exclusions of the sciences of his age, but he has nothing to tell us about any limitations of science today.

Rut even the latest scientific approaches to the study of time, as exemplified by Prigogine's

work, do not avoid serious difficulties. His examinations of irreversible processes suggest dramatic developments in physical theory, but a Bergsonian examination of his claims concerning the nature of time derived from these developments exposes problematic implications.

I wish to suggest that these problems could be avoided by retracing certain lines in Bergson's reasoning. Even if we agree with Prigogine's conviction that science can be an especially significant source of disinterested knowledge, Bergson may still have something to tell us about science as it is today. An examination of his thought may yet reveal how cognitive methods can limit and modify our experience. An awareness and understanding of such limitations would enable us to avoid some of the errors of our speculations.

On many points, Prigogine agrees with Bergson. Bergson had recognized the inability of classical science, with its mechanistic models, to grasp the essentially temporal aspects of reality. He had, according to Prigogine:

the good fortune to pass judgment upon science that was, on the whole, firmly established -- that is, classical science at its apotheosis, and thus identified problems which are indeed still our problems (OOC 93).

Bergson believed, as does Prigogine, that a recognition of time must be primary to any description of reality which aspires to adequacy. For both men classical science is in error in its neglect of time:

In referring to genuine time, Bergson uses the term "duration."

In my opinion, any resume of my views would distort them in their ensemble and by that distortion, expose them to a host of objections, if its author did not at once place himself at, and continually return to, that which I consider the very central point of the doctrine -- the intuition of duration. (HR 79)

He described *duration* as being "heterogeneous, qualitative, creative" (HE 79). Prigogine

quoted Bergson's statement, "Time is invention, or it is nothing at all" (OOC 92). Similarly, Prigogine agrees with Paul Valéry's claim, that "time is construction" (OOC 16). Both Bergson and Prigogine stress that time is not a homogeneous medium like space, for which all directions have equal status. They want to insist that we cannot reduce the difference between past and future (or the direction or "flow" of time) to an arbitrary choice, as we can choose to designate right and left in space merely by selecting the appropriate reference. Prigogine diverges from Bergson in his understanding of the roles of philosophy and science, and the relationship between physical and metaphysical knowledge.

Much of Bergson's later work developed from his early suspicions of a conflict between speculative (or disinterested) thought and practical thought, between *intuition* and *intellect* (Bergson's technical terms).

Intuition,

which yields the unmediated apprehension of

duration,

is according to Bergson the mode of thought appropriate to metaphysics, which aspires to a disinterested description of reality. The

intellect

is the mode of thought which divides the world up into pieces in order that we may plan the rearrangement of them to alter the world for our needs and desires. This carving-up of the world, which has its origin in the thought process of the

intellect,

violates the continuity of the world, although Bergson stresses that it is necessary for dealing effectively with the requirements of human life. Scientific method, according to Bergson.

confines itself to examining the necessary external relations between elements isolated through the application of the

intellect.

It is limited to providing us with practical knowledge of such items of this sort of relatedness.

Thus science is inappropriate as a means of providing a

disinterested

knowledge of nature.

As we have seen, Prigogine agrees with Bergson's criticism of classical science. Some of Prigogine's remarks echo Bergson's comments:

Reversible transformations belong to classical science in the sense that they define the possibility of acting on a system, of controlling it. (OOC 120)

Classical science was more a plan for controlling the world than a reflection of the structure of the universe. But where Bergson seems to claim that science as a whole will never be able to overcome its mechanical models and thus its neglect and rejection of genuine time, Prigogine believes that subsequent developments in chemistry and thermodynamics are finally leading science to overcome the limitations indicated by Bergson's criticisms:

Thus the limitations Bergson criticized are beginning to be overcome, not by abandoning the scientific approach or abstract thinking but by perceiving the limitations of the concepts of classical dynamics and by discovering new formulations valid in more general situations. (OOC 93)

He insists that science can do more than provide us with instrumental knowledge, that advances in science constitute an increased understanding of the world:

The moments of greatest excitement at scientific meetings very often occur when scientists discuss questions that are likely to have no practical utility whatsoever, no survival value -- topics such as possible interpretations of quantum mechanics, or the role of the expanding universe in our concept of time. (OOC 98)

Since Prigogine's project involves an attempt to suggest an example of disinterested knowledge (the rediscovery of time), his rejection of any claims that science is inappropriate to such knowledge is necessary to defend his work.

We must take notice of the passages which give evidence of Prigogine's view of the relationship between philosophy and science, and their respective roles. At the end of *Order Out of Chaos*, Prigogine and Stengers mention the argument between Bergson and Einstein:

We can now appreciate in a nonpolemical fashion the relation between science and philosophy. We have already mentioned the Einstein -- Bergson conflict. Bergson was certainly "wrong" on some technical points, but his task as a philosopher was to attempt to make explicit inside physics the aspects of time he thought science was neglecting. (OOC 301f)

Prigogine and Stengers criticize what they consider to be the Kantian perspective, that it is not the results of science, but science itself, which is to be judged by philosophy (OOC 88). Kant's limitation of science to the study of phenomena, like Bergson's claim that the methods of physics preclude its possibility of any encounter with *duration*, denies the scientists a right to disinterested speculation. The authors defend this right to scientists by pointing out that experimental results are not arbitrary, that scientists' accounts of the definite ways that nature responds to their probing must constitute disinterested knowledge of the world:

Nature cannot be forced to say anything we want it to. Scientific investigation is not a monologue. It is precisely the risk involved that makes the game exciting (OOC 5).

If it is the scientists' reliance upon natural experimentation that prevents scientific method from being a monologue, then what of the work of philosophers, who employ no such laboratories? Does Prigogine mean to suggest that all philosophy apart from science involves no risk, that philosophers' conclusions merely follow as reformulations of their pre-approved conceptions?

Prigogine and Stengers offer several remarks concerning *a priori* arguments. Referring to Voltaire's argument which rejects a world divided between necessity and change in favor of a universal determinism, they tell us that "however convincing they may sound, such

a priori

arguments can lead us astray" (OOC 258). Elsewhere they describe their outline for a cosmological scheme:

The scheme we have presented is not an *a priori* scheme -- deducible from some logical structure. There is, indeed, no logical necessity for dissipative structures¹ actually to exist in nature . . . Our scheme thus does not correspond to a logical or epistemological truth but refers to our condition as macroscopic beings in a world far from equilibrium. (OOC 300)

This disclaimer of any logical necessity to their theory here appears to be intended as a defense for their work against any possible antiphilosophical bias of the reader. It seems evident from these passages defending the virtue of scientific investigation and suggesting a distrust of logical argumentation that Prigogine and Stengers prefer that philosophers concern themselves with interpreting the results of scientific inquiry instead of devising arguments independent of scientific research, or prescribing limits on the significance of the future work of scientists. Their remarks suggest that philosophy should not lead science -- it should only follow.

Prigogine seems to approve Bergson only as such a follower. Since the only science Bergson had to interpret was that of his era, which was primarily classical science, Bergson was not justified in judging the whole of science, then, now, and in the future. This view of Bergson's work may appear convincing. but the argument might be misleading. Perhaps the origins of Bergson's arguments are not limited to interpretations of the sciences of his day. Is Prigogine justified in dismissing Bergson's view of the eternal limitations of science? We need to take a closer look at Bergson's arguments, their origins, and their implications.

Although it has been common practice to treat Bergson as a critic of the scientific theories of his time, some scholars have pointed out that Bergson's reasoning did not begin solely with the investigation of science, but primarily with detailed examinations of problems of his philosophic predecessors. As Heidseick relates in his work, *Henri Bergson et la notion d'espace*:

But the real dialogue is not engaged with Spencer or the associationists, but, above their heads with Aristotle, with Leibniz, with Kant.² (HBE 10)

Bergson's early Latin thesis, *Quid Aristoteles de loco senserit*, was according to Heidseick an attempt to set up a dialogue between the Aristotelian and Kantian viewpoints of the philosophy of space or place so as to develop a solution to their problems (I-IRE 33). Jacques Chevalier, a commentator as well as a personal friend of Bergson, wrote that:

Bergson did not set out from psychology; he arrived there, after starting from the mechanistic notion of time, and by "seeking" the concrete underlying mathematical abstractions. (HE 140)

In *Time and Free Will*, Bergson indicates his suspicion that homogeneous space does not exist externally, independent of thought. With Kant, Bergson believes that homogeneous space is ideal, having its source in our cognitive activities. He suggests that the question of the external reality of space is essentially the same as the question "whether space is in space" (TFW 91). How do we know that space is arbitrarily divisible? Bergson is able to answer that we know it to be so *a priori* because it is our own construction.

Bergson differs from Kant in stressing that homogeneous space is *not* an intuition which

presents itself to passive contemplation, but rather developed in humans as an instrumental form, probably in response to the challenges of human life. A homogeneous medium may be divided arbitrarily into a grid of units of any size or shape. If we insert the thought of such a form into our experience of the world, the world will then also appear to be arbitrarily divisible. The possibility of thinking the division of the world into separate units and of thinking any juxtaposition of them within a homogeneous medium provides an efficient means of altering the world to suit. As Bergson explains:

But in order to divide the real in this manner, we must first persuade ourselves that the real is divisible at will. Consequently we must throw beneath the continuity of sensible qualities, that is to say, beneath concrete extensity, a network of which the meshes may be altered to any shape whatsoever and become as small as we please; this substratum which is merely conceived, this wholly ideal diagram of arbitrary and infinite divisibility, is homogeneous space. (MM 278)

The diagram of homogeneous space and the division of this medium into isolated entities for which it provides, constitutes the form of practical thought, the *intellect*. This carving-up of the world which breaks any continuities of our experience is, according to Bergson, necessary for the effective satisfaction of the demands of human life. Mathematics, for example, provides a means to greatly increase our power over the world. But in order to count we need to treat items to be counted as absolutely separate from one another. If they were to merge with one another even slightly, their requisite unitary status would dissolve; their boundaries must isolate them absolutely. The items to be counted must also be treated as identical, as parts of a homogeneous medium. As we are told in grade school, if you are counting apples, you cannot include oranges, which would destroy the uniformity. But you must also ignore any differences between the various apples, since counting demands absolutely identical units. Bergson was concerned with this rejection of qualitative diversity, and especially with the isolation of part from part, this rejection of continuity which constitutes a limitation of the *intellect's* treatment of the world.

Scientific method, for Bergson, is the development of the *intellect par excellence*. Scientists first obtain an inventory of isolated entities, and then examine them with the intent of determining the sorts of external relations they sustain. Mathematical operations are performed on the quantitative values which have replaced any qualitative differentiations. Scientific method is a precise and systematic use of the cognitive form of homogeneity, the careful development of the practical, diagrammatic capacity common to human life.

Once we are dealing with absolutely isolated entities, we are limited in our ability to conceive

possible modes of activity. Entities which are wholly external to one another can only affect each other externally, and so the sort of relatedness appropriate to scientific method is external relatedness. This permits us to manipulate matter with matter, by learning to insert a physical influence between entities? By projecting the form of homogeneous space, the world appears as a plurality of objects absolutely separate from one another, externally related as in mechanics.

The practical value of the *intellect* is not questioned, but Bergson stresses that we must be careful that we do not shift from such practical thinking to attempts at disinterested speculations without an awareness of how our imposition of homogeneous form limits our experience of the world. We are bound to make erroneous speculations about the world if we fail to realize that the externality isolating the entities or stages of processes was our own contribution to our practical experience of the world. Then we might unjustifiably assume that the world, apart from our thought, can only consist of a plurality of elements isolated in their external relatedness; we might deny any possible continuity or teleology which our practical methods must ignore.

When an event is examined by the sciences, the spatial, homogeneous form is used as a diagram for temporal sequence. A prior cause is thought as absolutely separate from its effect which follows; a process is isolated and divided further into stages, each stage being absolutely separate from the next. The homogeneous form allows us to draw boundaries between stages wherever it seems the most promising as points for inserting our influence to alter the world to our ends. For example, we isolate a chemical process and divide it into a series of separate stages in anticipation of introducing our influence at the point between the stages, say to produce a compound possessing useful properties or to prevent a dangerous reaction from taking place. Such an application of cognitive form represents the past as a plurality of particulate events along a uniform line within a homogeneous medium. If we are unaware of the origin of this homogeneity, we might believe time itself to be this arbitrarily divisible line or surrounding homogeneous medium; time thus appears to lose its heterogeneity, its direction, its continuity. We might then conceive of our own lives as series of separate, externally related events or stages rather than as continuities.

Apart from science, this treatment of time as a homogeneous medium does have practical advantages, and without it we would be limited in our ability to organize our everyday activities. But this "clock time" is not genuine time, Just as we are aware that an arc of thirty degrees (as on a clock face) is not itself five minutes. But we might begin to believe that it is time itself if we fail to realize that practical thought does not reveal to us the world as it is apart from our practical cognitive form of homogeneity. Bergson concludes in *Matter and Memory*:

Homogeneous space and homogeneous time are then neither properties of things nor essential conditions of our faculty of knowing them: they express in an abstract form the double work of solidification and division which we effect upon the moving continuity of the real in order to obtain there a fulcrum for our action, in order to introduce into it real changes. They are the diagrammatic design of our eventual action upon matter. (MM 280)

Scientific method thus requires that the world be treated as a plurality of entities isolated within a homogeneous space, with a plurality of discrete events occurring within a homogeneous time. The selection of boundaries between both entities in space and events in time is determined by "the point where our possible action upon them ceases, where, consequently, they cease to interest our needs" (MM 278). The ontological inventory which results from scientific thought should not, then, be treated as though it had been presented to disinterested observers. Rather than something very common and obvious to everyone, purely disinterested observation is comparatively rare in most human lives, which are usually shaped by our needs and desires. Bergson describes disinterested experience as requiring "a great mental effort" (HB 79). There is a danger, then, when the scientist attempts to shift from usual methods to speculate on the nature of the world independent of his or her intervention, a danger which is not obvious. The entities which emerge through scientific investigation, and their external relatedness to one another, may not be the whole story of reality; the stages of processes and events separated from one another by external, causal relations may not be the whole story of time. They might even be nothing more than conceptions which effectively increase our powers of manipulation. Bergson denied the scientists any privileged access to disinterested knowledge.

He intended to clarify the distinction between practical and speculative, disinterested experience. The ideal of disinterested thought is to separate off all prejudices of the thinker, even all thinking shaped by practical concerns, from that which is contemplated. Disinterested thought must not modify the world in thinking the world but remain distinct from it. It is obvious that practical thinking and scientific method can affect the world in the resulting juxtaposition of material or physical entities, but Bergson's thought brings us to realize that the experience of the world as apprehended through scientific method is itself limited and modified even before any physical alterations are attempted. Our experience of the world as structured through the aid of the isolating, externalizing form of the *intellect* is not the experience of the world maintained in its purity apart from the admixture of our cognitive contributions.

Bergson's distinction between the *intellect* and *intuition*, between the mode of practical thought and the mode of speculative, disinterested thought, did not proceed merely from a recognition of the inadequacies of science in the late nineteenth-century. It developed from investigations of the treatments of relevant problems throughout the history of Western philosophy. Still, there is more to the origin of Bergson's distinction. His reasoning is not

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priori

in Prigogine's sense; it is not confined to deriving conclusions from the logical structure of some unexamined premise. Bergson was not a scientist, but this did not prevent him from attending to empirical evidence. Unlike the empirical scientist, who proceeds to consider observations of increasingly uncommon experimental situations for the purpose of increasing the range of available data, Bergson gathered his empirical evidence from his everyday experience with careful attention to the

common

characteristics. Even though the range of this data was not as extensive as that available to the scientist, this attention to what was common may have allowed him to discern what might elude those who focus upon the peculiarities of their specialized experiments. We might suspect that his perspective yields insights whose significance reach beyond a critique of 19th century science.

Prigogine claims that science need no longer be encumbered with the limitations cited by Bergson. He explains that it is the "internal development of science itself" rather than "philosophical criticism or empirical resignation," that has killed the classical science criticized by Bergson (OOC 55). Prigogine suggests that Bergson's practical/speculative distinction was his inheritance of Kant's suspect distinction between phenomenal knowledge and knowledge of things-in-themselves. We must next consider whether or not the recent changes in science render Bergson's distinction, with its warnings, obsolete.

Prigogine and Stengers describe in general terms the changes which have taken place:

What are the assumptions of classical science from which we believe science has freed itself today? Generally those centering around the basic conviction that at some level *the world is simple* and is governed by time-reversible fundamental laws. Today this appears as an excessive simplification. We may compare it to reducing buildings to piles of bricks. Yet out of the same bricks we may construct a factory, a palace, or a cathedral. It is on the level of the building as a whole that we apprehend it as a creature of time, as a product of culture, a society, a style. But there is the additional and obvious problem that, since there is no one to build nature, we must give to its very "bricks" -- that is, to its microscopic activity -- a description that accounts for this building process. (OOC 7)

Here the authors seem at first to suggest a shift from a concern with microscopic activity alone to a concern to find their explanations of the microscopic activity through reference to macroscopic systems. Such a shift would allow a focus upon possible whole-part relations

rather than the part-part, external relations characterized by classical mechanics. It would possibly allow us to transcend the limited perspective of treating all relatedness as external relations.

But then Prigogine and Stengers retreat from this prospect, suggesting that we must find the answers to our inquiries in the microscopic activity, which they think is analogous to unitary bricks. This division of nature into such essentially similar bound units conforms with Bergson's account of the intellect's projection of the arbitrary divisibility of space. However the authors conceive of the internal structure of such units of microscopic activity, if wholes are to be explained only in terms of their unitary parts, the possibility of recognizing any whole-part teleology is excluded from the outset. They indicate that they believe that this treatment follows from their claim that "there is no one to build nature."

Perhaps Prigogine anticipates that a serious consideration of explanations of microscopic activity in terms of macroscopic systems, of parts through reference to wholes, would introduce a teleology that he as a scientist might be concerned to avoid. But he might just be following the limitations of the form of practical thought. Whatever his reasons, the same attitude is affirmed later in *Order Out of Chaos*:

There can be no doubt that irreversibility exists on the macroscopic level and has an important constructive role, as we have shown in Chapters V and VI. Therefore there must be something in the microscopic world of which macro-scopic irreversibility is the manifestation. (OOC 258)

The principle difference between the approach which Prigogine recommends as indicated by recent developments in science and the approach of classical science appears to be the acceptance of irreversibility in time as a characteristic of some natural processes at all levels. His comments concerning reversible transformations identifies them as examples of the sort criticized by Bergson as characteristic of scientific knowledge:

Reversible transformations belong to classical science in the sense that they define the possibility of acting on a system, of controlling it. (OOC 120)

The reversible nature of such change and controlling the object through its boundary conditions are interdependent processes. (OOC 120)

Prigogine identifies science's acceptance of irreversibility with its rediscovery of time. We thus have two claims to examine: 1) science's discovery that there are actually irreversible processes in nature (as well as reversible processes) makes Bergson's distinction between practical and speculative knowledge obsolete, and 2) this discovery of genuine irreversibility is the rediscovery of time.

First, a world whose processes include those which are irreversible does indicate a world less susceptible to our control. But the acceptance of irreversibility and chance does not seem to alter the characteristics of science which Bergson criticized. If Bergson correctly characterized the method of classical science as involving the mediation of the cognitive form of homogeneity by the *intellect*, limiting our treatment of the world to a concern with entities and stages absolutely separate from one another and so limited to external relatedness, it seems that the new science envisioned by Prigogine is open to similar criticisms.

Even if the processes examined are acknowledged to be irreversible, and we cannot hope to return them to initial conditions, we might yet learn how to control the outcome when we encounter similar initial conditions, as we have learned how to arrest the development of diseases which we consider to be incurable in their advanced stages. Even though our control of such a process is limited by its apparent or real irreversibility, the boundaries separating its stages are still indicated, as Bergson says, by where we may have effect on them by physically acting on them. Other than as a practical device these boundaries defining the stages might not exist. And of course, the only way that we can conceive of relations between the stages is as external relations, the cause of any later stage being one of the earlier stages or a process within that earlier stage. When a shift is made from this practical knowledge to speculations about what the disease is, apart from our conceptual contributions, it is easy to unjustifiably assume absolute separation and external relatedness of stages as belonging to the disease, to the world itself.

Where Prigogine finds no external necessity between the stages of a process, he suggests chance or randomness. Such stages absolutely separated from one another in the homogeneous medium of the *intellect* can admit of no other than external types of relatedness. There may well be real chance or randomness, but there may also be relatedness other than external relatedness, which the methods common to practical thought and science cannot treat. Even with an acknowledgment of real irreversibility in time, scientific method retains the form of

practical thought, and Bergson's warnings of the potentiality for errors arising from confusing practical thought with speculative aspirations to disinterested knowledge are still pertinent.

We can next examine Prigogine's identification of science's acceptance of irreversibility with its rediscovery of time. We need to consider Prigogine's uses of the various temporal conceptions utilized in his work. Besides "irreversibility," he refers to the "arrow of time" and "unidirectional processes." We have already noted Prigogine's approval of poet Paul Valéry's claim that "time is construction."

In the preface to *Order Out of Chaos*, the authors indicate that scientists' new awareness of the role of randomness and irreversibility constitutes a rediscovery of time:

We are becoming more and more conscious of the fact that on all levels, from elementary particles to cosmology, randomness and irreversibility plan an ever-increasing role. *Science is rediscovering time.*
(OOC xxviii)

This randomness and irreversibility that scientists are discovering describe chemical and thermodynamic processes. These objective processes are not themselves identified with time, but "involve an arrow of time" (OOC xvii). The irreversibility, the unidirectionality of these processes is called the "arrow of time." Scientists are allegedly discovering time within the processes they examine. The following passage demonstrates the authors' use of the conception, the "arrow of time:"

Indeed, what could an arrow of time mean in a deterministic world in which both future and past are contained in the present? It is because the future is not contained in the present and that we go from the present to the future that the arrow of time is associated with the transition from present to future (OOC 277).

They also disagree with Einstein and recommend the identification of time with irreversibility and evolution:

Einstein emphasized that science had to be independent of the existence of any observer. This led him to deny the reality of time as irreversibility, as evolution (OOC 293).

If time is irreversibility, evolution and randomness, but is not itself an observed objective process, although irreversible processes "involve an arrow of time," then how are we to understand the authors' view of time? Prigogine and Stengers state that irreversibility is a mechanism. "Irreversibility is the mechanism that brings order out of chaos" (OOC 292).

Thinking of time in these terms might lead us to believe that the only evidence we have for rejecting the reversibility of time is to be found in the objective empirical observations of science. In this mood, the authors suggest that the only reason we cannot reverse the direction of time is a lack of information; if we had enough information, we could overcome entropy and reverse time:

However, to reverse the direction of time would need infinite information; we cannot produce situations that would evolve into our past! This is the entropy barrier we have introduced. (OOC 295)

It is precisely the infinite entropy barrier that guarantees the uniqueness of the direction of time, the impossibility of switching from one direction of time to the opposite one. (OOC 296)

If the barrier of entropy is *all* that guarantees time's unidirectionality, then the reversal of time is prevented only by physical constraints. But whether or not the characteristics of observed physical processes ensure time's irreversibility, logic does: no scientific observations are necessary to refute the claim that time is reversible.

Consider that we do not first become aware of time from the observation of irreversible processes, but rather we must first be aware of time in order to recognize which processes are irreversible. A recent article by Ferrel Christensen reminds us of this:

Maybe, that is, the human race has come to believe in the directionality of time as the result of observing all the irreversible processes that take place in time, much as it has in the case of the

up-down directionality of space. But this suggestion is also clearly wrong, as a matter of psychological history . . . We don't in any ordinary sense of the word *observe* that Q's always fall on the same temporal side of H's in otherwise symmetrical-seeming time; if anything, we observe that Q's

precede

or

follow

H's To be more precise, we see an H while remembering a Q, or have a fresh memory of Q while having an even fresher one of an H, or something of that nature. (E26: 237)

As Kant stated in his *Dissertation* of 1770, "The idea of time does not originate in, but is presupposed by the senses" (ID 59).

⁴ Our awareness of time cannot result originally from the experience of a succession. Our ability to discriminate between reversible and irreversible processes presupposes an awareness of temporal directionality; it is only by reference to time that we recognize a process as being reversible or irreversible, or that we experience a succession to be ordered temporally at all.

Even if we could reverse all processes this would not reverse time. Consider the following situation. Suppose we could reverse all of the events of our lives, bringing us back to the conditions of our childhoods, with our bodies, our homes, our world all returned to their former states. It would make no sense to call this a *reversal*, unless it were to occur *with respect to* something whose direction remained unaltered. Just as a reversal of a particle

in space

must consist of a change of direction with respect to other nonreversing physical entities, or with respect to an absolute space, a temporal reversal must occur with respect to some temporally nonreversing process of time. There must be some reference to constitute a reversal. But even if the only nonreversing process were our memory, wouldn't time's direction be unaltered, the

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of our childhood conditions occurring

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their original decay? It makes no sense to speak of a reversal of time, only of a reversal of processes

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time, or with respect to time.

If the reversal of each and every objective process, whether or not actually possible, could not together affect the direction of time, then how can we expect to find time's unidirectionality through the scientific examination of microscopic processes? We can no more ignore the logical difficulties exposed by this problem than we can accept contradictions in scientific theory. Logical conflicts demand a resolution, and in this case it seems that a resolution would require

that we abandon the belief that the reversibility of time is even conceivable, together with any hope of discovering time itself within any objective microscopic activity.⁵

I do not mean to deny that scientists' increasing awareness of irreversible processes will lead them to reconsider the importance of time. Time can be ignored, for all practical purposes, only if all processes are in principle reversible. The increasing prevalence of irreversible processes in the sciences *should* result in an increased interest in time among scientists. While both the reversibility *and* irreversibility of processes only make sense with respect to time, it is easy to ignore the importance of time if the assumed universality of reversibility renders the homogenous "time" of practical thought as a line rather than as a vector.

Although Prigogine and Stengers suggest that science provides knowledge that is more than merely instrumental, their conception of the status of this additional aspect of scientific knowledge seems unclear:

Science certainly involves manipulating nature, but it is also an attempt to understand it, to dig deeper into questions that have been asked generation after generation (OOC 291).

Prigogine and Stengers state that scientific method guarantees that nature is treated as an independent being. This indicates that this additional significance of scientific knowledge conforms to our conception of disinterested knowledge, knowledge of the world itself rather than merely of an appearance which owes its structure to our conceptual designs:

We believe that the experimental dialogue is an irreversible acquisition of human culture. It actually provides a guarantee that when nature is explored by man it is treated as an *independent* being. It forms the basis of the communicable and reproducible nature of scientific results. However partially nature is allowed to speak, once it has expressed itself, there is no further dissent: nature never lies. (OOC 44)

But they also tell us that the ideal of scientific descriptions of a world separate from our intellectual constructions is unattainable:

Whatever reality may mean, it always corresponds to an active intellectual construction. The descriptions presented by science can no longer be disentangled from our questioning activity and therefore can no longer be attributed to some omniscient being. (OOC 55)

Yet their principle concern seems to be to show that the temporality or ordering in time which scientists are discovering is an irreversibility somehow independent of our intellectual constructions, as though our conceptualizations have finally been forced, through developments within science, to determinations which reveal a temporality independent of them.

We might well sympathize with an uncertainty over our ability to attain a truly disinterested knowledge of nature. Bergson's insights indicate the potentiality for error when shifting from practical reasoning, with its instrumentally determined ontological inventory (and limited forms of relatedness), to aspirations to disinterested speculation. Bergson's treatment of the practical/speculative distinction might itself count as an example of one sort of disinterested knowledge, as a recognition of the intellectual form which prevents practical experience from being disinterested experience. It might be considered to be a disinterested knowledge of the structuring of experience. But is a disinterested knowledge of *nature*, of the sort with which scientists are sometimes concerned, possible? I would like to suggest that it is, even though, as Prigogine's work suggests, much of what has been counted as knowledge of reality must now be rejected or reevaluated. But real advances in disinterested knowledge of nature are unlikely without an awareness of our own contributions to the structuring of our practical, and thus our scientific, experience.

We might recognize the importance of Bergson's practical/speculative distinction and its cautions, and yet also find ourselves sympathetic with Prigogine and Stengers' insistence that we cannot force the outcome of laboratory experiments, that scientific data somehow indicates information which is not limited to an instrumental value. Perhaps we can combine these insights. Science could be an especially revealing source for disinterested speculation, if we realize that such speculation must be done indirectly, involving a conscious shift from practical to speculative thought. Our scientific data must be transformed through an awareness of the presence of our own isolating and externalizing influences. Once we are aware of these intellectual contributions to our practical experience, we can think hypothetically: "If our method necessarily involves the isolation of elements and stages of processes, limits us to treating all relatedness as external relatedness, then what can we say about the world if our instruments are affected as they are?" We must not then assume that there are no absolutely separate elements, or that there are no interactions which can accurately be described in terms of forms of external relatedness. But we must remember that scientific examinations *limit us to that way* of treating the world. Answering hypothetical questions of this sort will admittedly be more difficult and slower than merely piling together our scientific data, but we will not be misled as easily.

Prigogine and Stengers point in this direction when they recommend that science be as mindful of its failures as its successes. Their work shows that scientists' attempts to treat all processes as theoretically reversible processes have failed to account for the results of many experimental investigations. Although our ability to control the world might be maximized if we could always apply the homogeneous form of practical thought and then explain all results in terms of external, physically alterable relations between isolated entities or stages of processes, we find that all available data cannot be made to conform with this ideal scheme. This reluctance of the world to conform perfectly with our plans permits the results of scientific examinations to be sources of disinterested as well as practical knowledge. But to understand the significance of this incongruence for the disinterested knowledge of nature, we must pay close attention to the structure of practical thought and its role in scientific method. The insights attained through Bergson's philosophical reflection upon this structure should not be ignored.

References

BB -- Ilya Prigogine. *From Being to Becoming*. San Francisco: W. H. Freeman & Co., 1980.

OOC -- Ilya Prigogine and Isabelle Stengers. *Order Out of Chaos*. Toronto; New York; London; Sydney: Bantam Books, 1984.

HB -- Jacques Chevalier. *Henri Bergson*. Auth. trans. Lillian A. Clare. New York: Macmillan, 1928.

HBE -- François Heidsieck. *Henri Bergson et la notion d'espace*. Paris: Le Cercle du Livre, 1957.

TFW -- Henri Bergson. *Time and Free Will*. Auth. trans. F. L. Pogson. London: George Allen & Unwin and New York: Macmillan, 1910.

MM -- Henri Bergson. *Matter and Memory*. Trans. Nancy Margaret Paul and W. Scott Palmer. London: George Allen and Unwin, 1911.

E26 -- Ferrel Christensen. "Time's Error: Is Time's Asymmetry Extrinsic?" *Erkenntnis*. Volume 26, March 1987.

ID -- *Kant's Inaugural Dissertation of 1770*. Trans. W. J. Eckhoff. New York: 1894.

Notes

¹When the destruction of a physical system produces a more complex physical or chemical structure this new structure is called a *dissipative structure* because greater energy is required to sustain the new order (OOC xv).

²Mais le véritable dialogue ne s'engage pas avec Spencer où les associationnistes, mais, pardessus leur tête avec Aristote. avec Leibniz, avec Kant."

³Homogeneous space, for Bergson, *is externality*, not another external object; this further explains his remark concerning the question of the reality of homogeneous space.

⁴The original Latin, as in *Immanuel Kants Werke*, in gemeinschaft mit Herman Cohen, Arthur Buchena, Otto Buck, Albert Gorland, B. Kellennar., herausgegeben von Ernst Cassirer (Berlin: Verlegt bei Bruno Casserer, 1922). 2:415, reads as follows: 'Idea temporis non oritur, sed supponitur a sensibus.'

⁵ Prigogine's approach might be described as an attempt to demonstrate the reality of time by discovering it through external, objective, scientific observations. The Bergsonian approach, I believe, would be instead to point out the common error of denying reality to all but external objects or objective processes, defending the reality of both time and subjectivity.