Abstract: After having been a Whiteheadian for decades, Abner, under the influence of Lovejoy’s book, “The Revolt against Dualism,” no longer accepts Whitehead’s philosophy. In this paper I try to challenge this change of heart, as well as suggest a modification of Whitehead’s philosophy that allows for an elegant interpretation of the EPR/Bell correlations.
Whitehead’s Philosophy and Quantum Mechanics (QM)

A Tribute to Abner Shimony
I. The Challenge

- Last year, when Abner and I conducted a dialogue on Whitehead’s philosophy and QM, in Vienna, on the occasion of Anton Zeilinger’s sixtieth birthday conference, Abner assigned me the task of winning the argument and restoring his enthusiasm and love for Whitehead.
I tried and failed.
But I haven’t given up.
I consider this talk a second chance to fulfill Abner’s task. In less than an hour you will know whether this time I succeeded.
Following J. M. Burgers, who established, back in the 1960’s, the intriguing connection between Process philosophy and quantum mechanics, Abner has been one of the champions, if not the champion of this connection. It was primarily A. Lovejoy’s book, *The Revolt Against Dualism*, that convinced him otherwise. The point that convinced him seems to be the vagueness in the term “experience,” which made it so far from the usual meaning of the term that it seemed to him virtually meaningless.
Early on Abner showed that certain modifications of Whitehead’s philosophy as originally formulated are indispensable. As we shall see, other modifications are needed to deal with the entanglement issue. The question is, whether the modified version enriches or destroys the Whiteheadian paradigm.
II. Whitehead’s Philosophy and QM

- Since the very existence of the relationship of Whitehead’s philosophy (also known as “Process philosophy”) and QM may be news for some of us, I will begin by establishing this intriguing connection.
The connection is based on the Whiteheadian concept of “actual entities,” also known as “actual occasions,” “throbs of experience,” or “pulses of experience,” depending on the context. They are, according to Whitehead, the “atoms of reality.” The enormous gulf between Whitehead and contemporary scientific thinking is revealed already at this stage: According to Whitehead this universe we live in is an alive universe, a universe of experiences, rather than a universe of mostly inanimate matter. We will come back to this point in a few minutes.
Actual entities are processes (hence the name “Process philosophy). They are the processes of their own self creation. They have both an objective and subjective aspects. And — as soon as they are completed they die. Dying, they become immortal in the sense that the fact that they did exist cannot be erased. In saying that actual entities are processes of their own self creation, creativity is implied. Whitehead’s universe is not a completely deterministic one. It is a universe characterized by the phrase “creative advance into novelty.”
The time constraints do not allow me to elaborate further. I am mentioning these points just to whet your appetites. Being introduced to Whitehead’s thinking is a challenging, difficult and rewarding experience.

But how is it related to QM?
III. Schrödinger’s Principle of Objectivation

- Before addressing the question of a possible correspondence between Process Philosophy and QM, we need to put one more ingredient into the soup. This ingredient is Schrödinger’s “Principle of Objectivation.”
When I recently discussed with Abner the role of the great physicists as philosophers, he said that Schrödinger is “in a class by himself.” I agree.
According to Schrödinger, science, as it is practiced now, is based on two principles. First, the belief that nature is comprehensible, and, second, the principle of objectivation.
“By this [i. e., by “the principle of objectivation”] I mean what is also frequently called the ‘hypothesis of the real world’ around us. I maintain that it amounts to a certain simplification, which we adopt in order to master the infinitely intricate problem of nature. Without being aware of it and without being rigorously systematic about it, we exclude the Subject of Cognizance from the domain of nature that we endeavor to understand. We step with our own person back into the part of an onlooker who does not belong to the world, which by this very procedure becomes an objective world.”
IV. The Correspondence between Process Actual Entities and Collapse

- I suggest that the QM process that corresponds to an actual entity is the collapse of a quantum state. Like an actual entity, a collapse is an atemporal process that is not completely deterministic. Hence there is room for creativity.

- I used the term “atemporal process.” What are these?
The process of self-creation of an actual entity is not a process in time; it is, rather, an atemporal process leading to the momentary appearance of the completed actual entity in spacetime. Quoting Whitehead: “[In the process of self-creation which is an actual entity] the genetic passage from phase to phase is not in physical time...the genetic process is not the temporal succession...Each phase in the genetic process presupposes the entire quantum.”
Here are some examples of atemporal processes:

1. The creation of time in Plato’s *Timaeus* comes after many other acts of creation — all of these must be atemporal.

2. The Platonic “participation” of the Forms in sensible things is another example of atemporal processes.

3. Whitehead’s thinking was Platonic, yet his precision was a mathematician’s. Therefore his inclusion of atemporal processes in his system is significant.
Having digressed to met atemporal processes. Let us return now to the correspondence between actual entities and the collapse.
The final result of the collapse is “an elementary quantum event” in spacetime. The final phase of an actual entity is, likewise, an event in spacetime. The correspondence works, except for one problem.
The problem with the correspondence of the collapse to an actual entity is that QM, as a part of our science, is subject to the principle of objectivation. The collapse, as it is now understood, has nothing subjective about it. An actual entity, however, has both a subjective aspect and an objective aspect.
The main conclusion I am driving to is this:

The collapse corresponds to an actual entity to the extent that our science would allow it to; i.e., it corresponds to the objective aspects of an actual entity.
When one follows, point by point, the characteristics of actual, entities, one is amazed to what extent one can think of collapse as an objectivized actual entity.
V. Bell’s Correlations and Actual Entities

- The relationship between Whitehead’s thought and QM is a two-way street. QM adds credence to the Whiteheadian vision, and Whitehead’s philosophy helps us understand the apparently weird aspects of QM. We will now embark on a reexamination of EPR and Bell’s correlations from a Whiteheadian perspective.
The EPR/Bell correlations *seem* to show that *something* (call it “influence”) travels faster-than-light, but this faster-than-light travel cannot be harnessed to transmit *signals*. How can we understand this strange state of affairs?
A modification of Process philosophy is needed. Not knowing about entanglement, Whitehead naturally assumed that an actual entity is spatially confined to a small region. Let’s modify Process philosophy by dropping this requirement. Let’s assume that one actual entity can end up occupying two or more distant locations.
- How is this modification related to the EPR/Bell situation?
In an EPR/Bell experiment two events that take place at the same time seem to influence each other, regardless of the distance between them. In principle this distance can be astronomical. Even when the events take place very far apart, they seem to be “entangled,” they “feel” each other.
Is it possible that such a connection takes place because both events are a single creative act, a single “actual entity,” arising out of a common field of potentialities? A single act of transition from the potential to the actual that occurs in two places is not the result of the propagation of anything between these two places; hence the speed of light barrier does not apply.
This is why such creative acts cannot be utilized to transmit signals faster than light: To transmit a signal two creative acts are required. The transmission and reception of a signal is, precisely, the creation of a situation where one completed actual entity affects another. Such transmissions cannot propagate faster than light.
The distinction between influences and signals reflects the distinction between two events that are components of a single act of self-creation and two events that are connected, yet distinct creative acts.
A mundane analogy may help clarify this distinction: Think of a dancer in the act of performing. The single creative act we have been discussing corresponds to the dancer gracefully lifting her left leg and right arm in one harmonious movement. In contrast, the two distinct events correspond to the appearance of an itch on the dancer’s left leg, and scratching with her right hand.
The graceful lifting of arm and leg is really a single movement; its two correlated components take place simultaneously. The two events of itching and scratching are separated in time, since one is a reaction to the other.
The material covered so far is a prelude to the big question that we are now ready for. I will put this way:
The main point of Lovejoy’s objection, which Abner endorses, is the loose use of terms like “experience,” or “mentality.” Differently stated, the possible meaning of such terms, as Whitehead uses them, is so vague that one wonders whether they mean anything at all.
This is a serious objection. I believe, however, that by using these terms, Whitehead tries to indicate something that is not vague at all. The idea I believe he had in mind (and, obviously, this is my formulation) is this: If the basic units of the universe are dead, no amount of complexity will make them alive.
This negation of the physicalistic approach means that the presence of mentality at the human level tells us that some level of mentality, however insignificant in itself, must be present at all levels. Abner’s term “protom mentality” is appropriate in this context.
And here is another point. To the best of my knowledge, Lovejoy was not aware of either the correspondence of Process philosophy and QM or of the issue of entanglement. Thus he staked his position against Whitehead being blissfully ignorant of the two unexpected, major triumphs of Process philosophy in terms of what Whitehead called “elucidation of things observed.”
Because of the results of what Abner called “experimental metaphysics,” we no longer have the luxury of blissful ignorance. One cannot ignore a metaphysical approach that corresponds so well to QM and gives an elegant explanation of the characteristics of entanglement.
I rest my case.
V. Is There an Agreement, At Least in Part, between Abner and Myself?

- Let me begin by stating what I am trying to achieve and what I am not trying to achieve in this presentation. I am not trying to arrive at is not a metaphysical statement that is final.
Rather, I accept Whitehead’s statement, “There remains the final reflection, how shallow, puny and imperfect are efforts to sound the depth in the nature of things. In philosophical discussions, the merest hint of dogmatic certainty as to finality of statement is an exhibition of folly.” (A. N. Whitehead, *Process and Reality*, D. R. Griffin and D. W. Sherburne, eds., The Free Press, 1978, p. xiv)
What I am trying to arrive at is the metaphysical system that is most true in the following sense:

- (1) it feels true
- (2) it is non-dogmatic in the sense of being open to possible changes, and
- (3) it is in line with the findings of physics in general and quantum mechanics in particular.

Does a modified version of Process Philosophy fit the bill?
(1) It does feel true. If it doesn’t, then Abner has to explain howcome he was a Whiteheadian for so many decades.

(2) It is non-dogmatic. As we saw, it can be modifies to great advantage and no major damage.

(3) It is in line with the finding of QM in general, and the EPR/Bell entanglement in particular.
So, to conclude,
here is my $64,000 question to Abner:

- Given that we are not looking for a final metaphysical statement, would you agree that a modified Process philosophy is the best one we currently have?
redo this calculation
generally

given 2 isolated systems

\[ \frac{d}{dt} \left( \rho g \right) = 0 \]

\[ \frac{\partial}{\partial x} \left( \rho g \right) = 0 \]

\[ \frac{\partial}{\partial y} \left( \rho g \right) = 0 \]

\[ \frac{\partial}{\partial z} \left( \rho g \right) = 0 \]

\[ \text{equilibrium condition} \]

if we define \( S = \frac{1}{2} g \ln \frac{a}{b} \)

\[ \frac{\partial S}{\partial x} + \frac{\partial S}{\partial y} + \frac{\partial S}{\partial z} = 0 \]

\[ \text{equilibrium condition} \]

\[ \frac{\partial S}{\partial x} = \frac{1}{2} g \text{Ln} \]
redo the calculation
as generally
for 2 isolated systems

\[ \frac{d}{dx} \begin{pmatrix} g_1(x) \\ g_2(x) \end{pmatrix} = 0 \]

\[ \begin{pmatrix} \frac{d}{dx} g_1(x) \\ \frac{d}{dx} g_2(x) \end{pmatrix} = 0 \]

\[ \frac{\partial g_1}{\partial y_1} = \frac{\partial g_2}{\partial y_2} \]

\[ \frac{d}{dy_1} g_1(x) = \frac{d}{dy_2} g_2(x) \]

equilibrium condition
if we define \( S = k_1 \ln \frac{g_1(x)}{g_2(x)} \)

\[ TDS = -\frac{\partial S}{\partial T} - \frac{\partial S}{\partial V} \]

\[ \frac{\partial S}{\partial T} = \frac{\partial g_1}{\partial T} \]

\[ \frac{\partial S}{\partial V} = \frac{\partial g_2}{\partial V} \]
redo this calculation as generally

for 2 isolated systems

\[ \begin{align*}
\frac{\partial}{\partial x_1} (g(x_1)) &= 0 \\
\frac{\partial}{\partial x_2} \left( g(x_1) g(x_2) \right) &= 0 \\
\frac{\partial}{\partial x_3} \left( g(x_1) g(x_2) g(x_3) \right) &= 0
\end{align*} \]

equilibrium condition

\[ \frac{\partial}{\partial x_1} \left( g(x_1) g(x_2) \right) = 0 \]

if we define \( S = \ln g(x) \)

\[ \frac{\partial S}{\partial x_1} + \frac{\partial S}{\partial x_2} = \frac{\partial}{\partial x_1} \ln g(x_1) + \frac{\partial}{\partial x_2} \ln g(x_2) = 0 \]

\[ \frac{\partial}{\partial x_1} \left( g(x_1) g(x_2) g(x_3) \right) = 0 \]

\[ \frac{\partial S}{\partial x_1} + \frac{\partial S}{\partial x_2} + \frac{\partial S}{\partial x_3} = 0 \]
redo this calculation as generally

for 2 isolated systems


\[ \frac{\partial (g_2)}{\partial x_2} = 0 \]

\[ \frac{\partial g_1}{\partial x_1} \cdot \frac{\partial g_2}{\partial x_2} = 0 \]

equilibrium condition

if we define \( S = k_B \ln \]

\[ \frac{dS}{dx_1} = \frac{1}{2} \cdot \frac{1}{x_1} \]

\[ \frac{dS}{dx_2} = \frac{1}{2} \cdot \frac{1}{x_2} \]

\[ \frac{dS}{dx_1} + \frac{dS}{dx_2} = \frac{dU}{dU} + \frac{dP}{dV} \]

\[ S = \frac{dU}{dU} + \frac{dP}{dV} \]
redo this calculation as generally


\[ \frac{\partial}{\partial u} (g_2) = 0 \]

\[ \frac{\partial}{\partial u} \]
redo this calculation as generally
for 2 isolated systems

\[ \frac{\partial}{\partial u} \delta g_1 = 0 \]

\[ \frac{\partial}{\partial v} \delta g_2 = 0 \]

\[ \frac{\partial}{\partial u} \delta g_1 + \frac{\partial}{\partial v} \delta g_2 = 0 \]

\[ \delta h_1 = \frac{1}{2} \frac{\partial}{\partial u} \]

\[ \delta h_2 = \frac{1}{2} \frac{\partial}{\partial v} \]

\[ \delta S = \delta h_1 + \delta h_2 \]

\[ \delta S = \delta h_1 + \delta h_2 \]

\[ \delta S = \delta h_1 + \delta h_2 \]

\[ \delta S = \delta h_1 + \delta h_2 \]

\[ \delta S = \delta h_1 + \delta h_2 \]
redo this calculation as generally

for a non-trivial system

\[ \frac{\partial}{\partial N} \ln g = \frac{\partial}{\partial N} \ln h \]

\[ g = g(N,\mu,\Sigma) h = h(N,\mu,\Sigma) \]

...
redo this calculation generally

\[ \frac{\partial (g_{ij})}{\partial u_i} = 0 \]

or

\[ \frac{\partial g_{ij}}{\partial u_i} + \frac{\partial g_{ij}}{\partial u_j} = 0 \]

de and

\[ \frac{1}{g} \frac{\partial g}{\partial u} = \frac{1}{g} \frac{\partial g}{\partial u} \]

\[ \text{equilibrium condition} \]

if we define

\[ S = \frac{1}{g} \ln g \]

\[ \frac{1}{g} \frac{\partial g}{\partial u} = \frac{1}{g} \frac{\partial g}{\partial u} \]

\[ \frac{\partial S}{\partial u} = \frac{\partial g}{\partial u} \]

\[ dS = \frac{1}{g} \frac{\partial g}{\partial u} du = \frac{\partial g}{\partial u} dU \]
redo this calculation as generally

see 2: isolated systems

now... chapter 15

acting through constraint

employing $SU$

$g_{12} = g_1(x, u, sv)g_2(x, sv)$

post only $\Rightarrow$ inverse $g$

equation $\Rightarrow$ $g(x)$

decide by $g_{12}$

\[
\frac{1}{g_1} \frac{\partial g_{12}}{\partial x_1} = \frac{1}{g_2} \frac{\partial g_{12}}{\partial x_2}
\]

equation condition

if redefine $S = \ln L$

\[
\frac{dS}{dx} = \frac{d\ln L}{dx}
\]

recall $\Delta S = dU + PdV$

\[
\frac{dS}{dx} = \frac{1}{L} \frac{dU}{dx} + \frac{P}{L} \frac{dV}{dx}
\]

$\Rightarrow (8)$
redo this calculation as generally

\[ \frac{\partial g}{\partial x} = 0 \]

\[ \frac{\partial}{\partial x} (g g_i) = 0 \]

\[ \frac{\partial g}{\partial x} + \frac{\partial g_i}{\partial x} = 0 \]

equilibrium creation

if we define \( S = \frac{1}{T} \ln \theta \)

\[ \frac{dS}{dV} = \frac{dU}{dV} + \frac{P dV}{dV} \]

\[ ds = \frac{1}{T} dU + P dV \]
redo this calculation as generally
for 2 isolated systems

\[ \frac{\partial S}{\partial U} = 0 \]
\[ \frac{\partial S}{\partial N} = 0 \]

\[ g_g = g(N, U, z, S) g(N, U) \]

\[ g_1 = g(N, U, z, S) g(N, U) \]

\[ \begin{align*}
0 &= \frac{\partial g_1}{\partial z} \\
&= \frac{\partial g}{\partial z} \\
&= \frac{\partial g}{\partial N} \frac{\partial N}{\partial z}
\end{align*} \]
redo this calculation

as generally

for 2 coupled systems

we have the equations

\[ \frac{\partial^2 (g_{ij})}{\partial \mu^2} = 0 \]

or

\[ \frac{\partial g_{ij}}{\partial \mu} + \frac{\partial g_{ij}}{\partial \nu} = 0 \]

equilibrium condition

if we define:

\[ S = \frac{d}{d \mu} \ln \]

[\text{equivalent to}]

\[ S = dS / d \mu \]

\[ \frac{dS}{d \mu} = \frac{dS}{d \nu} \]

\[ \frac{dS}{d \mu} + \frac{dS}{d \nu} = 0 \]

[\text{equilibrium condition}]

for the system.
redo this calculation generally

for 2 isolated systems

\[ \frac{d}{du} (g \phi) = 0 \]

\[ \frac{\partial \theta}{\partial u} \phi \frac{\partial g}{\partial u} = 0 \]

\[ \frac{\partial g}{\partial u} \phi \frac{\partial \theta}{\partial u} = 0 \]

\[ \frac{\partial \theta}{\partial u} \phi \frac{\partial g}{\partial u} = 0 \]

\[ \frac{\partial g}{\partial u} \phi \frac{\partial \theta}{\partial u} = 0 \]

\[ \frac{d \ln g}{du} = \frac{\partial \ln g}{\partial u} \]

\[ \frac{d \ln \theta}{du} = \frac{\partial \ln \theta}{\partial u} \]

\[ \text{equation condition} \]

if we define \( S = k_B \ln \theta \)

\[ \frac{d S}{d u} = \frac{d \ln g}{du} + \frac{d \ln \theta}{du} \]

\[ \frac{d S}{d u} = \frac{1}{\theta} \frac{d \theta}{d u} + \frac{1}{g} \frac{d g}{d u} \]

\[ \text{recall } T d s = d u + P d V \]

\[ d s = \frac{d u}{T} + \frac{d V}{P} + \frac{d \theta}{g} \]
redo the calculation

\[ \frac{\partial}{\partial x} (g_1 g_2) = 0 \]
\[ \frac{\partial g_1}{\partial x} g_1 + \frac{\partial g_2}{\partial x} g_1 = 0 \]
\[ \frac{\partial g_1}{\partial x} + \frac{\partial g_2}{\partial x} = 0 \]

\[ \text{equilibrium condition} \]
\[ \text{if we define } S = k \ln T \]
\[ \frac{\partial S}{\partial x} = 0 \]
\[ \frac{\partial S}{\partial x^2} = 0 \]
redo this calculation as generally

\[ \frac{\partial (u_1)}{\partial u_1} = 0 \]

or \[ \frac{\partial u_1}{\partial u_1} + \frac{\partial u_2}{\partial u_2} + \frac{\partial u_3}{\partial u_3} = 0 \]

equilibrium condition

if we define \( S = \frac{1}{T} \ln \frac{dS}{dU} \)

\[ \frac{dS}{dU} = \frac{dU}{R} + P dV \]
redo this calculation generally

\[ \frac{\partial}{\partial \mu} g(x) = 0 \]

or \[ \frac{\partial}{\partial \mu} g(x) + \frac{\partial}{\partial \mu} g(x) = 0 \]

divide by \[ g(x) \]

\[ \frac{1}{g(x)} \frac{\partial g(x)}{\partial \mu} = \frac{1}{g(x)} \]

\[ \Rightarrow \frac{\partial}{\partial \mu} x = \frac{\partial}{\partial \mu} \ln x \]

\[ \Rightarrow T \frac{\partial S}{\partial T} = P \frac{\partial V}{\partial P} \]

\[ \Rightarrow \Delta S = \int dU + P \Delta V \]
do this calculation generally


\[
\frac{\partial (\rho g)}{\partial x} = 0
\]

or

\[
\frac{\partial x}{\partial x} + \frac{\partial y}{\partial y} = 0
\]

driven by

\[
\frac{1}{\rho g} \frac{\partial (\rho g)}{\partial x} = \frac{1}{\rho g} \frac{1}{\rho g}
\]

well

\[
T dS = dU + P dV
\]

\[
\frac{dS}{\rho g} = \frac{1}{\rho g}
\]
redo this calculation, as generally

\[ \frac{d}{dx} \left( g(x) \right) = 0 \]

or \[ \frac{g'(x)}{g(x)} + \frac{g''(x)}{g'(x)} = 0 \]

divide by \( g(x) \)

\[ \frac{1}{g'(x)} \frac{d}{dx} g(x) = \frac{1}{g'(x)} \frac{d}{dx} g(x) \]

\[ ds = \frac{d}{dx} U \]

recall \( TdS = \partial Q + PdV \)

and \( S = k \ln T \)
redo this calculation

2. isolated systems

\[ \frac{\partial (g_1 g_2)}{\partial u} = 0 \]

\[ \frac{\partial g_1}{\partial u} \frac{\partial g_2}{\partial v} - \frac{\partial g_1}{\partial v} \frac{\partial g_2}{\partial u} = 0 \]

\[ \frac{\partial}{\partial v} \left( \frac{\partial S}{\partial u} \right) = 0 \]

\[ \frac{\partial S}{\partial u} + \frac{\partial S}{\partial v} = 0 \]

\[ S = \int dU + P dV \]
redo this calculation as generally

for 2 isolated systems

\[ g_{sys} = g_1(n, v_1, s_1) g_2(n, v_2) \]

non-heat processes

\[ \frac{\partial}{\partial n} \left( g_{sys} \right) = 0 \]

\[ \frac{\partial}{\partial v} \left( g_{sys} \right) = 0 \]

\[ \frac{\partial}{\partial s} \left( g_{sys} \right) = 0 \]

\[ \frac{\partial}{\partial n} \left( g_1 \right) + \frac{\partial}{\partial v} \left( g_1 \right) + \frac{\partial}{\partial s} \left( g_1 \right) = 0 \]

\[ \frac{1}{n} \frac{\partial n}{\partial n} = \frac{1}{v} \frac{\partial v}{\partial v} + \frac{1}{s} \frac{\partial s}{\partial s} \]

\[ \frac{\partial n}{\partial n} = \frac{\partial v}{\partial v} + \frac{\partial s}{\partial s} \]

\[ \frac{\partial}{\partial n} \left( g_{sys} \right) = \frac{\partial}{\partial v} \left( g_{sys} \right) = \frac{\partial}{\partial s} \left( g_{sys} \right) = 0 \]

\[ \frac{\partial}{\partial v} \left( g_{sys} \right) = \frac{\partial}{\partial s} \left( g_{sys} \right) = 0 \]

\[ \frac{\partial}{\partial n} \left( g_{sys} \right) = \frac{\partial}{\partial v} \left( g_{sys} \right) = \frac{\partial}{\partial s} \left( g_{sys} \right) = 0 \]

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\[ \frac{\partial}{\partial n} \left( g_{sys} \right) = \frac{\partial}{\partial v} \left( g_{sys} \right) = \frac{\partial}{\partial s} \left( g_{sys} \right) = 0 \]
redo this calculation as indicated

\[ \frac{2}{x} \left( g(x) \right) = 0 \]

\[ \frac{\partial}{\partial x} g(x) = 0 \]

\[ \frac{\partial}{\partial x} \left( g(x) \right) = 0 \]

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redo this calculation
as previously

for 2 isolated systems

\[
\frac{3}{\beta} \approx 0
\]

\[
\frac{\partial}{\partial \beta} \approx 0
\]

\[
\frac{\partial S}{\partial \beta} = \frac{\partial}{\partial T} \left( T \frac{\partial S}{\partial T} \right)
\]

\[
S = -T \ln(\omega)
\]

\[
\frac{\partial S}{\partial T} = \frac{\partial}{\partial \beta} \approx 0
\]

\[
\ln(\omega) = \frac{\partial S}{\partial T}
\]

\[
\frac{\partial \ln(\omega)}{\partial \beta} = \frac{\partial}{\partial T} \left( T \frac{\partial S}{\partial T} \right)
\]

\[
\ln(\omega) = \frac{\partial S}{\partial T}
\]
redo the calculation, as generally

for 2 isolated systems

using thermodynamics

\[ g_{Si} = g(S, V) \]

plug only into g

plug in g(S, V) into g_{Si}

drivs by \( S \)

\[ \frac{1}{\beta} \frac{dS}{dU} = \frac{1}{\beta} \frac{dS}{dU} \]

now up to

\[ \frac{1}{\beta} \frac{dS}{dU} = \frac{1}{\beta} \frac{dS}{dU} \]

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redif. eqns: \( S = k \beta U \)

\[ \frac{dS}{dU} + \frac{dS}{dU} = \frac{dS}{dU} \]

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