FREUD'S THEORIES IN THE LIGHT OF FAR-FROM-EQUILIBRIUM RESEARCH

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[ABSTRACT: Freud's theories are shown to rely on an equilibrium-seeking model derived from nineteenth century physics. This model is traced through Freud's concepts of neuronal inertia; the pleasure principle; the primary and secondary systems; instincts; the compulsion to repeat; the Nirvana Principle; the death instinct; and resistance. Quandaries concerning adaptation as well as the delay of discharge are attributed to the limitations of Freud's equilibrium model. Next, the main features of far-from-equilibrium research are recounted, primarily from the work of Prigogine but properties of chaotic systems. The concepts of self-oganization and dissipative structure, sensitivity to the environment, energy exchange, and nonlinearity help resolve the quandaries of adaptation in Freud's theories.]

The Dilemna of Development in Psychoanalysis

Priding itself on being a **developmental** psychology, psychoanalysis has been concerned with the developmental stages in the life span as well as the development taking place during analysis (Zukier 1985, 8-9). Freud himself struggled with understanding how development during analysis could take place in the face of his patients' resistance to it. He came to understand development as a response to environmental forces:

> ...the phenomena of historical development must be attributed to external disturbing and diverting influences. The elementary living entity would from its beginning have had no wish to change...Every modification which is thus imposed upon the course of the organisms's life is accepted by the conservative organic instincts and stored up for further repetition. Those instincts are therefore bound to give the deceptive appearance of being forces tendingtoward change and progress, whilst in fact they are merely seeking to reach an ancient goal by paths alike old and new (Freud 1920, 38).

But, if the "conservative" instincts are **non-prospectively** "merely seeking to reach an ancient goal", how do they permit the "external disturbing and diverting influences" to lead to the **prospective** movement of development?

According to Frank Sulloway, Freud answered this question by turning to Ferenczi's concept that the individual organism progresses by repeating phylogenetic evolution (Sulloway 1983, 399, 401). By viewing ontogenetic development as a repetition of ancestral reactions to uncomfortable experiences, Freud reformulated <u>instinct as the urge to restore previous states of existence</u>. He could now explain several puzzling phenomena that had to do with patients' unwillingness to progress: the repetition compulsion, fixation to trauma, and transference. By understanding instinct as restoration, Freud was connecting it with his dominant psychological principle of <u>equilibrium-seeking</u>: "the impulse to discharge completely, or to keep at a constant level, the sum of internal psychical tension" (Sulloway 1983, 402). In this way, the paradoxical road that instinct follows toward development was now included under the same equilibrium-seeking explanation as found in all of Freud's major psychological conceptions.

But this linkage of development to equilibrium-seeking leads to a dilemna: equilibrium-seeking mechanisms might be good for explaining psychological <u>stability</u>, but these same mechanisms, by their very nature, mitigate against development. For example, the equilibrium-seeking mechanisms of the pleasure or Nirvana principles inhibit "excitations", either internal or external, that are threatening to upset equilibrium. Yet, development as an "external disturbing and diverting influence" must act on the individual in the form of "excitations". These excitations, though, will be dampened by the operation of equilibrium-seeking. How can development take place in the face of such powerful equilibrium-seeking principles?

Furthermore, it is difficult to see how Freud's non-prospective model of development can explain the prospective development occuring during successful treatment. We can see an example of this difficulty by tracing how analysis is supposed to lead to a "cure". Therapeutic development ensues through encouraging transference and then analyzing it (Zukier 1985, 13). Underneath the transferential phenomena, Freud perceived the instinct of the repetition compulsion. During psychoanalysis, the equilibrium-seeking, conservative instinct to repeat is given free reign. The analysis of this instinct is expected to overcome its propensity toward repetition. But, if analysis overcomes the equilibrium-seeking repetition compulsion, it must itself be operating according to <u>a different principle than equilibrium-seeking</u>.

Freud, however, was bound to the equilibrium-seeking model he inherited from nineteenth century physics. A non-equilibrium dynamic was simply not available in his day and age. The good news is that a non-equilibium model has recently emerged in physics with research into far-from-equilibrium, "chaotic", and self-organizing systems. By contrasting Freud's equilibrium-based model with from far-from-equilibrium research, enigmas about the process of development may now be accessible to resolution.

Equilibrium Models in Nineteenth Century Science

Two primary schools of thought exist about the origins of Freud's thought: that psychoanalysis originated from Freud's nineteenth century scientific training or that Freud's most significant insights emerged only when he rejected the science he inherited in favor of a pure psychology of his own delineation (Sulloway 1983, 2-5, 422-425). These two schools, though, can be bridged by the <u>equilibrium-seeking model</u> of physical systems which was basic to both nineteenth century science as well as Freud's psychological theories.

Equilibrium models in mechanical dynamics. In the nineteenth century, principles of inertia and conservation required that a physical system tend toward equilibrium by keeping constant levels of such factors as velocity, momentum, or energy (D'abro 1939, 214-237). These principles were just the latest outcropping of equilibrium-seeking models going back to the laws of inertia and conservation anticipated by Galileo, expounded on by Kepler and Descartes, and mathematically formulated by Newton (Cohen 1985, 210-211). Thus, Kepler introduced the term "inertia" (from the Latin for indifference or laziness) when describing the tendency of matter to come to rest when an external "mover" ceased acting on it (Cohen 1985, 210). Similarly, Newton's Law of Inertia postulates that an object at rest tends to stay at rest while an object in motion tends to remain at the velocity of that motion. Without an external force acting on it, the system would always strive to keep itself at inertial equilibrium.

Along the same lines, the Law of the Conservation of Energy was based on an equilibrium-seeking principle: the Hamiltonian constant which demanded that, for an isolated system, the sum total of the potential and kinetic energies will always retain the same value (D'abro 1939, 232-237). For example, an apple in a tree has a certain amount of potential energy, but as it falls it is releasing kinetic energy. The total energy quantity, though, will remain at its equilibrium amount. The historian of physics A. D'abro elaborated the equilibrium-seeking consequences of this energy conservation principle by stating:

> ...in the particular case where the initial position of rest is one of minimum potential energy, the particle remains motionless; the particle is then said to be in a position of **equilibrium**. Thus a stone that has fallen to the ground has the smallest potential energy possible and hence remains at rest (D'abro 1939, 217; my emphasis).

"Equilibrium" was, thus, defined as the state toward which the system inclines. Therefore, the tendency to reach this state of equilibrium accounts for the dynamics of the system.

Equilibrium models in thermodynamics. The pursuit of a more efficient steam engine in the early nineteenth century led to the study of thermodynamics or the interaction of heat energy with mechanical systems (Prigogine and Stengers 1984, 111ff). Pondering the origin of the heat caused by boring a hole into metal, Joule' discovered that the amount of heat produced always had the same quantitative relationship to the amount of mechanical energy expended. Heat was consequently seen to be another kind of energy, that, along with mechanical energy, must be conserved.

The First Law of Thermodynamics proposed that the sum total of all the various forms of energy, including heat, remains constant and, hence, is conserved (Van Ness 1969, 1ff.). A consequence was the strong equilibrium-seeking principle: any excess of energy will be discharged. This Law of the Conservation of Energy was so important Joule equated the order or organization of a system with its conserving tendencies (Prigogine and Stengers 1984, 108,109). Moreover, Helmholz (whose "School" of Medicine Freud was trained in) averred that the invariance of physical law throughout the whole of nature was ruled by this single principle of conservation (Prigogine and Stengers 1984, 110).

Another repercussion of thermodynamics was that an isolated system with an unequal temperature distribution would seek thermal equilibrium, or the equalization of temperature differences (Prigogine and Stengers 1984, 105). This tendency to equalize differences is also connected to the Second Law of Thermodynamics which contended that the total entropy or probalistic disorder of an isolated system can only remain constant or increase (D'abro 1939, 349-360). An energy gradience in a system is a sign of **order or structure** since it is probalistically unlikely for this gradience to occur in the absence of some ordering or structuring principle. Therefore, according to the Second Law, the equilibrium conditions of an isolated system are the state of highest entropy or disorder possible for the system. Since <u>an equilibrium-seeking system will tend to the highest state of disorder</u>, order must be accounted for by appealing to something other than an equilibrium-seeking process. This is an important point which we shall return to when discussing far-from-equilibrium dynamics.

Summary of the equilibrium model in the nineteenth century.

1. An isolated system seeks equilibrium which is a state of rest or lowest energy. Equilibrium-seeking dominates an isolated system to the extent that departures from equilibrium, such as the accumulation of an energy surplus, are dampened. An isolated system will resist changes threatening to disrupt its equilibrium or move it out of inertia.

2. An equilibrium-seeking system is isolated. The conservation and inertial principles demand the isolation of a system from its environment because energy exchange or forces from the outside will disrupt the constancy of inertia or energy.

3. An equilibrium-seeking system will naturally seek the highest state of disorder, equivalent to the smoothing out of all differences within the system.

The Equilibrium Model in Freud's Work

Russett pointed out how social scientists who wanted to put their theories on a sure scientific foundation found the equilibrium-seeking approach especially congenial: as a scientific concept borrowed from physics, equilibrium meant more than a simple balance of forces--it implied an explanatory framework for understanding the dynamics of a "whole system in terms of its constituent elements" (Russett 1966, 3,10). Thus, Freud, wanting to insure that his psychoanalysis was a true science, relied on physics and its equilibrium model as the prototype for the dynamics of the system of the mind. The psychoanalytic theorist David Rappaport described this equilibrium model in Freud's work: "...Freud's psychology is a psychology in terms of energy distribution, the basic tendency of which is to eliminate states of disequilibrium, that is to equalize potentials" (Rappaport 1951, 327, fn.33). We will now identify this equilibrium-seeking model in many of Freud's most important concepts.

Freud's Physics and the Constancy Principle. Schooled in the "biophysical" assumptions of the Helmholz School of Medicine, Freud was thoroughly familiar with physics since his professors, Brucke and Meynert, adamantly endeavored to introduce Gustav Fechner's ideas, primarily the Law of the Conservation of Energy, into physiology and neurology (Jones 1957, 371ff). Freud himself admitted to the strong influence of Fechner (Freud 1920, 8-9). In fact, Freud seems to have been so taken with physics that he saw it as an authoritative template against which to measure psychoanalysis (Freud 1914, 77; Freud 1915, 117).

Modifying Fechner's ideas into the equilibrium "principle of constancy", Freud as early as the "Sketches for the 'Preliminary Communication' of 1893" proposed:

> ...the nervous system endeavors to keep constant something in its functional relations that we may describe as the 'sum of excitation'. It...(disposes) associatively of every sensible accretion of excitation or by discharging it by an appropriate motor reaction (Freud 1892,153-154).

Freud called these constancy demands "the most fundamental conditions of the psychical mechanism" (Freud 1896, 221).

In the "Project for a Scientific Psychology" of 1895, Freud built his entire theory on a constancy precept, the "principle of neuronic inertia" in which neurones tend to divest themselves of energy excitations and thereby avoid unpleasure: "In that case **unpleasure** would have to be regarded as coinciding with ...an increasing quantitative pressure... Pleasure would be the sensation of discharge" (Freud 1895, 312). This "unpleasure" concept later became the "pleasure" principle which Freud defined in equilibrium terms: "a tendency...to free the mental apparatus entirely from excitation or to keep the amount of excitation in it constant or to keep it as low as possible" (Freud 1920, 62).

Equilibrium in the primary and secondary systems. In the Interpretation of Dreams, Freud employed an equilibrium model in explaining the primary and secondary systems (Freud 1900). Thus, the primary system, the system "Ucs", is directed toward securing the "free" discharge of excitation. However, the secondary system or "Pcs", with its more "bound" energy, seeks the discharge of excitations, but in a more roundabout way: through thinking or exploratory activity. Freud stressed that the equilibrium-seeking "unpleasure" principle regulates the course of excitation even in this second system (Freud 1900, 601).

In "Beyond the Pleasure Principle", Freud emphasized that the binding of the free energy of the unconscious was "a preparatory act which introduces and assures dominance of the pleasure principle" (Freud 1920, 62). The binding still operates under the sovereignty of the equilibrium-seeking pleasure principle.

Instincts and the Compulsion to Repeat. In "Instincts and their Vicissitudes", Freud had postulated an equilibrium model for the goal of an instinct which "is in every instance satisfaction, which can only be obtained by removing the state of stimulation at the source of the instinct" (Freud 1915a, 122). Later, however, in "Beyond the Pleasure Principle", Freud equated instinct with "an urge inherent in organic life to restore an earlier state of affairs" (Freud 1920, 36). According to Sulloway, Freud was here trying to resolve the dilemna of the origin of the repetition compulsion: by an instinct desiring to restore an earlier state of affairs, it is doing just what the compulsion to repeat is all about--the tendency of "inertia in organic life" (Sulloway 1983, 399-415). Both ways of understanding instinct amount to an equilibrium-seeking process.

The Nirvana Principle and the Death Instinct. In his final period of theorizing, we find an equilibrium-seeking model underpinning Freud's concepts of the Nirvana Principle and the Death Instinct. Freud defined the Nirvana Principle: "The dominating tendency of mental life, and perhaps of nervous life in general...the effort to reduce, to keep constant or to remove internal tension due to stimuli" (Freud 1920, 56). In the same paragraph, Freud stated that the Nirvana principle "is one of the strongest reasons for believing in the existence of the death extinct."

According to Sulloway, the death instinct, intimately related to the equilibrium-based proclivity of life to restore earlier states of affairs, is linked by Freud to Fechner's equilibrium-based concept of stability (Sulloway 1983, 408, fn 8). Freud went so far as to conclude that the pleasure principle actually serves the death instinct. Here, he indicated the equilibrium-seeking inclination of the death instinct to dampen excitations, a feature of the pleasure principle as well.

Resistance. At the heart of resistance is the patient's reluctance to give up their neurosis. According to Freud:

> These facts throw light (on the) peculiar 'psychical inertia',which opposes change and progress, (as) the fundamental precondition of neurosis...If we search for the starting pointof this special inertia we discover that it is the manifestation of very early linkages...between instincts and impressions and the objects involved in those impressions... this specialized 'psychical inertia' is onla different term...for ...a 'fixation'

(Freud 1915b, 272).

"Psychical inertia" as fixation indicates the relation of resistance to the equilibrium-seeking tendency of both the compulsion to repeat as well as the instinctual urge to return to the past. By mimicking repression in opposing unacceptable thoughts or feelings, resistance is close to the equilibrium-seeking neuronal inertia which serves to dampen any excitation of "quantity" (see Goldstein 1989).

Problems with Freud's Equilibrium Model

No place for change. One advantage of Freud's equilibrium-based model was that it cogently accounted for the maintenance or stability of psychological functioning. However, there is a serious question whether equilibrium-based models can account for adaptation or development in living organisms. For example, the renowned evolutionary biologist Waddington criticized such theories for being unable to explain temporal adaptation (cited in Wilden 1980, 139). Similarly, questions have arisen about how an equilibrium model can explain morphogenesis or the development of differentiated forms for differentiated functions in living organisms (Wilden 1980, 351-394). Even in economics, equilibrium-based models have been criticized for applicability only to conditions of rest and stasis (Russett 1966, 79).

An equilibrium-based retort to these criticisms would be that equilibrium can be a dynamic not just a static condition, and that this dynamism can account for change. Thus, life processes can be related to dynamic equilibrium. Examples of dynamic equilibrium in living processes are the changes in biochemical reactions inherent in the rhythms of "internal clocks" (Glass and Mackey 1988, 19-34). However, these "clock" rhythms are periodic recapitulations, over the course of time, of previous conditions, and, hence, real progressive development or change is ruled out. In dynamical terms, these "clocks" are explained as operating under the regime of a periodic attractor (see Abraham and Shaw 1982). Therefore, the origin of real, non-repetitive development still remains a mystery in dynamic equilibrium models.

The qualitative factor and reality. Another limitation of the equilibrium model can be seen in Freud's own doubts about a pure equilibrium model of the pleasure principle. In "The Economic Problem of Maoschism", Freud conjectured that if the pleasure principle were identical with the Nirvana Principle, every pleasure would coincide with a lowering of mental tension due to stimulation and every unpleasure with a heightening of the same (Freud 1924). Yet, the fact remains that pleasure can be associated with an increase of tension as in sexual pleasure:

> Pleasure and unpleasure, therefore, cannot be referred to an increase or decrease of a quantity...It appears that they depend, not on this quantitative factor, but on some

> characteristic of it which we can only describe as a **qualitative** one (Freud 1924, 160-161; my emphasis).

The introduction of this "qualitative" process seems to have been an admission by Freud that the equilibrium-seeking model was inadequate. Bound by the physics of his time, however, he didn't have access to anything better.

This "qualitative" factor, connected to the delay of discharge, is also related to the binding of the energy of the primary process by the operation of the secondary principle, representing the postponement of gratification due to reality. Reality acts on the internal mechanisms of the mind as a binding or inhibition of discharge. An analogy would be the action of a piston on an isolated cylinder of gases. Because of equilibrium-seeking conservation principles, the mechanical action of the piston must increase some other energy parameter such as heat. Since heat causes the gases in the cylinder to only push back that much harder against the piston, the result is that the system now has an even greater urge to discharge energy.

Similarly, reality as limitation effecting the psyche would only serve to increase internal excitation or charge, leading to a further increase in the tendency to discharge. Therefore, the equilibrium-seeking mechanisms are only given greater impetus. Freud's "qualitative" factor that can surmount this difficulty must not, therefore, be operating on a purely equilibrium-seeking model.

Far-from-equilibrium Research

Equilibrium models in thermodynamics emerged from studying such isolated and mechanical systems as the steam-engine. However, far-from-equilibrium models have emerged from the study of such non-isolated and non-mechanical systems as the weather, ecology, and biochemical reactions (see Berge, Pomeau, and Vidal 1984; Briggs and Peat 1989; Crutchfield, Farmer, Packard, and Shaw 1986; Davies 1988; Glass and Mackey 1988; Gleick 1987; Haken 1981; Jantsch 1980; Nicolis 1989; ; Prigogine and Stengers 1984; Stewart 1989). This research has shown that it is only in systems totally isolated from their environments that equilibrium-seeking dynamics dominate. A system in a constant energy exhange with its environment, however, may develop into a far-from-equilibrium state, whose characteristics differ fundamentally from the equilibrium model. Some physicists have gone so far as to claim that the new paradigm emerging in chaos and far-from-equilibrium research is even a more radical shift than occurred with either relativity or quantum mechanics (Ford 1989, 348-372).

An example of far-from-equilibrium system dynamics. The Nobel Prize Winner Ilya Prigogine offers the "Benard Instability" as an example of a far-from-equilibrium system.(Prigogine and Stengers 1984, 142-144) A liquid in a container is heated from the bottom, creating a temperature difference between the top and bottom of the container. Since temperature gradience is a departure from thermal equilibrium, the system will seek to restore thermal equilibrium by diffusing heat. However, the Benard system is not isolated, it is subject to continuing external heat and therefore, the normal path toward thermal equilibrium via diffusion is no longer the most effective. Instead, a more effective means for the conduction of heat energy is generated: the startling propagation of circular wave-like convection currents called "Benard cells". These ordered "cells" show a spontaneous <u>self-organization</u> which is maintained as long as the heat exchange with the environment continues.

A colleague of Prigogine, Gregoire Nicolis has analyzed in detail the dynamics of self-organization taking place in the Benard Cell (Nicolis 1989). In the condition of thermal equilibrium existing before the application of heat, temperature, density and spatial structure are homogenous. Internal temperature gradience emerges as the system responds to the environmental temperature gradient which is called by Nicolis a "nonequilibrium constraint". "Constraint" is somewhat misleading with its connotations of confinement or pressure on the system. Instead, what is effected by the "constraint" is the system's propensity to equilibrium. For example, in chemical experiments with the Belousov-Zhabotinsky reaction, the "nonequilibrium constraint" keeps the system from reaching chemical equilibrium by <u>pumping out</u> of the system reaction products whose presence would maintain chemical equilibrium (Nicolis 1989, 320, 321).

In the case of the Benard Instability, since heat causes lower density, the internal temperature difference causes a corresponding difference of density within the system with the lower density volumes nearer the source of heat. Next, a fluctuation in the system may cause a small volume of lower density liquid to displace upward. This small volume of lower density liquid will then find itself in a more dense region, and the Archimedean force will tend to propel this small volume in an upward direction. At the same time, an opposite effect may happen in small volumes in the upper, colder part of the liquid: downward displacements of higher densities caused by chance perturbations will be propelled downward. But, the convection currents don't arise until a critical threshold is reached:

> The reason why these currents do not appear as soon as delta T (temperature differentiation) is not strictly zero ...is that the destabilizing effects are counteracted by the stabilizing effects of the viscosity of the fluid, which generates an internal friction opposing movement, as well as by thermal conduction, which tends to smear out the temperature difference between the displaced droplet and its environment (Nicolis 1989,318).

When the critical threshold has been reached the nonlinear relationships among the elements of the system are revealed, and the perturbations are amplified. Prigogine has pointed out that amplification leading to self-organization doesn't happen with just any fluctuations, "but only with those that are 'dangerous'--that is, those that can exploit to their advantage the nonlinear relations guaranteeing the stability of the preceding regime" (Prigogine and Stengers 1984, 206). Thus, the self-organization that occurs requires three factors: a critical level of gradience from the nonequilibrium constraint; a system defined by nonlinear relationships among its elements; and perturbations.

Dissipative structures. The self-organizing Benard cells break the undifferentiated symmetry of the equilibrium state, unfolding in a complex and ordered fashion (Nicolis 1989, 328). The self-organization that can occur in far-from-equilibrium systems are called "dissipative structures" because they dissipate or transfer energy to the environment without decomposing in the process. In a similar vein, the quantum physicist Erwin Schrodinger conceived of living organisms as ordered like these dissipative structures, their orderliness achieved by the system "sucking" it from the environment (Schrodinger, 1967, 196) Dissipative structures have not only been observed in the laboratory but are thought to underlie the kaleidoscopic patterns seen in the weather, fluid turbulence, eco-systems, and living organisms (Briggs and Peat, 138-143).

Prigogine has interpreted dissipative structures as <u>order through the amplification of fluctuations</u> since the self-organization of the system can be considered an ordered adaptation to environmentally induced changes (Prigogine and Stengers 1984, 159). To explain the dynamics of these non-equilibrium dissipative structures, Jantsch uses the analogy of a man who stumbles, loses his equilibium, and can only avoid falling by continuing to stumble forward (Jantsch 1980, 32). This "stumbling forward" is the new stability of the dissipative structure. The organization of dissipative structures follows what the German physicist Haken calls an "order parameter", a mode of functioning of the system as a whole in which the components of the system are "enslaved", ie, they act in a coherent and cooperative organizational pattern (Haken 1981, 125-127).

Because of the Second Law of Thermodynamics, under equilibrium-dominating conditions, new order and coherence would be extremely unlikely (Nicolis 1989, 336) However, dissipative structures introduce a new kind of order, a type of creative adaptation to the environment through revealing potentialities hidden in the non-linearities of the system (Nicolis 1989, 332; see also Swenson 1989 who has demonstrated how environmental gradience in conjunction with the dissipative surfaces of attractors builds up systemic complexity in order while insuring maximal entropy production). Similarly, in a chaotic system, microscopic fluctuations can be influence systemic behavior on the macroscopic level, the so-called "butterfly effect" (Gleick 1987, 20-23; Cruthfield, et.al. 1986, 53).

Sensitivity to the environment. Prigogine has pointed out how the "Benard cells" are due in part to the effect of gravity on the liquid system (Prigogine and Stengers 1984, 163). Density gradience and nonlinear amplification work in concert with gravity leading to self-organization. In a purely equilibrium-based system, however, gravity would not play such a role in amplification of symmetry breaking. A far-from-equilibrium condition, though can be ultra-sensitive to small environmental effects. In fact, an energy exchange between system and environment can lead to a situation in which <u>a fluctuation is amplified until it invades the whole system</u>.

Energy exchange and discharge. In an equilibrium-seeking system, the system's organization resists gradience or fluctuations by diffusing or "discharging" them. But, in a far-from-equilibrium system, dissipative structures may emerge, instead, in response to fluctuations. The new, more inclusive relationship of system and environment now has dominion over the tendency toward discharge. The exchange with the environment is maintained by the internal non-equilibrium of the system (Jantsch 1980, 32).

Accordingly, a dissipative structure doesn't hold or inhibit discharge, it holds or maintains order and organization as long as the environmental exchange is maintained. Therefore, a far-from-equilibrium based system is not dominated by the building-up of energy and the consequent need for a compensating discharge. The energy isn't "bound", it is simply ordered in a new way according to a new principle.

A Far-from-equilibrium Model for Psychoanalysis

Because of the ubiquitous heritage of the equilibrium-seeking model, its almost automatic to consider the organization of a system in terms of the stabilizing principles that operate to maintain equilibrium. However, the radically different implications of a far-from-equilibrium model demand a revised conception of the dynamics of non-isolated systems including psychological functioning.

The ego and development. A far-from-equilibrium system can be a developmental model par excellence for it is in the very nature of such a system to be sensitive and responsive to the environment, thereby fostering developmental adaptation. That is, a far-from-equilibrium system can be understood as <u>developing</u> via stages of self-organization as its environment undergoes changes that effect the system. This is what Prigogine suggests happens in the case of morphogenesis in living organisms, but here we are applying this concept to mind as a psychological system (Prigogine and Stengers 1984, 172, 189).

What if the ego, as the original "bound energy" zone, is conceived as a kind of dissipative structure, which facilitates exchange with the environment and maintains internal sytemic order? As a dissipative structure not dominated by equilibrium-seeking, the ego, then, would not seek to discharge excess energy that threatens equilibrium. Instead, energy is "held", so to speak, in the organization or order of the ego's dissipative structure. This dissipative organization is a more efficient method of exchange with and adaption to the environment (see Swenson 1989).

This understanding of the ego as dissipative structure should be contrasted with other ways of understanding the ego's adaptive structure. For example, Rappaport offered the following conception of psychotic ego structures: "It is a rather common occurence for energy distribution which usually strives for discharge, when they are prevented from doing so, to structuralize to prevent or regulate their own discharge" (quoted in Hartmann 1964, 203). But this psychotic ego structure is the result of dammed-up energy seeking other avenues of discharge, whereas the ego as dissipative structure does not need other avenues looking for discharge and, thereby, creating psychotic structures.

Ego as dissipative structure is a way to conceptualize what the famous ego psychologist Hartmann emphasized as the ego's "synthetic" or organizing function (Hartmann 1964, 62; Blanck and Blanck 1974, 86). The function of the ego, according to Hartman, is adaptation to the environment via the reality principle which represents the modification imposed by the ego on the function of the two other principles. However, Hartmann resorted to equilibrium-seeking in explaining this ordering, synthetic function (Hartmann 1964, 63). But, according to the Second Law of Thermodynamics, an equilibrium-seeking system seeks disorder, not order. Therefore, Hartmann would have needed to explain how the ego as an equilibrium-seeking principle would include order.

To be sure, Hartmann was uncomfortable in equating the ego's adaptative capacity with the equilibrium-seeking tendencies of the Nirvana or pleasure principles (Hartmann 1964, 85-86). Yet, he still retreated to understanding the ego's reality principle as as a homeostatic, stabilizing principle (Blanck and Blanck 1974, 86-87). Recognizing that this homeostatic principle was a new aspect added to Freud's earlier principle, he, like Freud, was without the benefit of a far-from-equilibrium physics and, therefore, could not adequately elucidate this new aspect.

Nonequilibrium research, however, has shown how gradient environments and internal nonlinearity can work in concert to induce self-organization, a correlated systemic order which maintains the Second Law while at the same time exhibits adaptation to the environment (see Swenson 1989). The ego as self-organized dissipative structure would then be a principle of organization not bound by the dilemnas of equilibrium-seeking. Furthermore, unlike Freud's focus on external "disturbing forces", development would now have both an internal and an external cause: an environmental nonequilibrium constraint and an internal psychological system operating according to nonlinear relationships among its elements (see the present author's paper "A Nonequilibrium, Nonlinear Approach to Organizational Change" in the current volume, particularly the sections on nonlinearity).

The ego, the reality principle, and adaptation. Far-from-equilibrium research can offer a resolution of the quandary of the reality principle and secondary process. First, let's consider "reality" as analogous to the environment and/or the boundary conditions of a far-from-equilibrium system. Boundary conditions are the physical limitations of the system (eg, the container of the liquid in the Benard cell); the environment is the nonequilibrium constraint, eg, the heat source in the Benard Instability.

With the ego as a dissipative structure and reality as the system's environment, responsiveness of the ego to the environment is the creative aspect of its synthetic function. Under the equilibrium-based model, such creativity would be extremely unlikely (Nicolis 1989, 336). Yet, in a far-from-equilibrium-based model, this creativity could be explained without having to get caught up in the conundrums about equilibrium that Freud and Hartmann are inevitably led.

Only from within the confines of an equilibrium model, would the reality as the source of inhibition of discharge be be a problem. A far-from-equilibrium paradigm supercedes this necessity by offering an explanation of the maintenance of stability without the need for an equilibrium-seeking discharge.

Consequently, delay is not the relevant issue--energy just does not build-up in an equilibrium-seeking manner.

Psychoanalytic treatment as the creation of a far-from-equilibrium system. Previously, we encountered the paradoxes that surround conceiving psychoanalytic treatment as an arena which allows the the repetition compulsion, transference, and resistance free reign. Both the repetition compulsion and transference clearly function according to an equilibrium-seeking model: they both seek to restore earlier conditions whereby departures from equilibrium are dampened. Therefore, in themselves they do not offer a means for development.

Treatment efficacy depends on working through by means of the analysis of the repetition compulsion, resistance, and transference. Indeed, the therapeutic process puts the ego into a condition in which it cannot remain an isolated system-- it is put into a condition of exchange with its environment, ie, the analyst. The transferential situation demands an adaptation on the ego's part, but a change resisted by the equilibrium-seeking dynamics at work in the repetition compulsion, transference, and resistance. In fact, the "artificial illness" created in the transference neurosis can be considered a bringing-to-the-fore of the equilibrium-seeking mechanisms that are inhibiting development.

The "working-through" may be inducing a far-from-equilibrium condition by contrasting the equilibrium dominated articificial illness with the reality of the therapeutic relationship (Goldstein 1988, 22). To some extent, this is analogous to the crisis induced on the Benard liquid by the introduction of a continuous heat exhange from the environment. Only if the "working-through" goes beyond equilibrium-seeking can there be the possibility of therapeutic development.

CONCLUSION

We are so accustomed to equilibrium-based systems that its hard to conceive any other alernative. It's as if the only option to an equilibrium system is a random system with no discernable order. Even well into the twentieth century, psychoanalytic theorists have been trapped in such an outlook. For example, Rappaport expressed such a tendency: "Let us assume that what we call the drive-needs of the organism are disequilibria in energy-distribution. **Let us assume that the principles of physics hold here and such disequilibria tend toward reestablishment of equilibrium**" (Rappaport 1951, 659; my emphasis). Within the confines of this equilibrium model, *the principles of physics, i.e., the dynamics of a system, must be seen as dominated by the inclination to restore equilibrium.*

Research into chaotic and far-from-equilibrium systems, however, has revealed systemic principles not previously entertained. The concept of dissipative structures with their "order through fluctuations" provides a new understanding of the dynamics of organized systems. Thus, adaptation and development can be viewed as the sensitivity and adaptiveness of a far-from-equilibrium system to the environment; and the delay or inhibition of discharge no longer need be apprehended as increases in equilibrium-seeking tension. . These far-from-equilibrium insights can provide a more inclusive understanding of the dynamics of both stability and development, stability being now seen as the limiting case of far-from-equilibrium dynamics.

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