Thinking, Analyzing, Dreaming in Complexity

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Abstract

We present the broad outlines of the complexity paradigm and argue for its capacity to accommodate psychoanalysis. The central thread of the argument is recursiveness as the generative engine of complexity — explicitly present in narcissism, but more generally in the singular status of the sexual drive. We illustrate this argument through the example of theories of dreaming.

Keywords : Psychoanalysis ; Complexity science ; Epistemology

Introduction

The term "complexity" has two meanings. The first is used profusely in everyday language and in the media. A phenomenon is declared "complex" whenever thought fails to analyze it in a simple, readily communicable way. In fact, the more accurate term in this case would be *complication*. Instead of saying "it's complex," one should more properly, if less elegantly, say "it's complicated." Complication stems from a set of factors that can, at some cost but always in principle, be broken down into elementary constituents by following the Cartesian method of reducing the complicated to the simple.

The second meaning of the term is technical. Complexity is then defined not negatively, but through the positivity of its properties. One of these is that a complex phenomenon is qualitatively distinct from the mere assembly of its elementary constituents. It is at once more than their sum, and also less, as Edgar Morin has noted, since the emergence of complex systems carries a cost — the cost of their emergence and the cost of maintaining their existence[1]. This cannot be grasped through simplification alone. Knowledge of the constituents of the substrate in which a complex phenomenon is realized, and of the factors that appear to determine it, is necessary but insufficient. A direct approach to complexity, as complexity, is therefore imperative. In this technical sense, which we adopt here, complexity is no longer a face-saving notion invoked to mask our incapacity to understand a given phenomenon. It is a robust epistemic concept. It grounds a paradigm of knowledge and deploys a method and a lexicon for the intelligibility of the real. By applying this method and this lexicon to the field of psychoanalysis, we hope to explore a perspective dear to us : that of better situating psychoanalysis within the scientific field, without reducing or distorting it.

Recursive Causality

The best way to introduce complexity is to revisit the problem of causality. For the cause — that is, the process by which a determining object creates a determined phenomenon — is reassessed within the complexity paradigm. The problem of causality runs through the entire history of thought and is bound up with the history of philosophy itself. A few pivotal moments can be isolated.

The question of causality first received mythological and religious answers : magic, gods, fate, and occult forces were invoked to explain natural phenomena. Socrates, according to Plato, drew attention to the necessary distinction between the cause of a fact and the circumstances required for that

fact to occur. Building on the pre-Socratic philosophers, Aristotle distinguished the material cause (the marble block that potentially contains the form of the statue), the formal cause (the plan of execution), the efficient cause (the sculptor's labor), and, his own original contribution, the final cause (the completed statue). For each of these causal dimensions there is a temporal sequence : the determinant always precedes the determined.

Much later in the history of ideas, for the empiricist Hume, all ideas, from the simplest to the most complex, originate in perceptual experience. But the empiricist interpretation of causality poses a problem. When a moving billiard ball strikes a stationary one, the latter moves after the impact. The first ball is thus the cause of the second's motion. Yet the phenomenon of causation — the process itself — is in itself unobservable. Hume concludes that the idea of causality results from the experience acquired through the repetition of determining actions, through what he calls "the constant conjunction" of habits. Causality here, too, is sequential : the determinant temporally precedes the determined.

Hume's billiard-ball metaphor is of interest because it was later revisited in the history of ideas — this time using three balls instead of two. If three billiard balls collide simultaneously, it becomes impossible to determine the resulting trajectory of each. As soon as three independent bodies (that is, independent variables) interact simultaneously, their evolving trajectories become indeterminate and thus irreducible to analysis.[2] Complexity, one might say, is born as soon as three independent orders of factors interact simultaneously.

Finally, the Kantian moment inaugurates a shift in the understanding of causality. Kant posits the idea of causality as a principle of pure reason. But for Kant causality can be reversible : a consequence may in turn influence its cause, since when phenomena are simultaneous, the principle of reciprocal action applies. This reciprocal action creates a new whole. As Kant puts it, things that are simultaneous are reciprocally coordinated as causes of one another with respect to their determination — a wholly different kind of connection from the simple relation of cause to effect, in which the consequence does not in turn determine its principle and thus does not form a whole with it (as, for instance, the world's creator and the world itself do not form a whole). The understanding follows this same procedure when it conceives of a thing as divisible : just as, in the first case, the members of a division exclude one another while remaining linked within the whole, so too, in the second case, the parts are each represented as possessing (qua substance) an existence independent of the others, yet united within a single whole.[3]

The complexity-theoretic notion of cause draws on the extension of this reciprocal action. In complexity, causality is no longer linear but recursive. The determined feeds back onto the determinant and modifies it in turn, to the point where it becomes impossible to distinguish them, except by conventionally positing an origin. Recursive causality between two elements creates a new element that encompasses both. Formally, one might write the following sequence :

1. **A** — The element A exists. This may be a factor, a set of factors, a force, or any phenomenon whatsoever.
2. **A** $\rightarrow$ **B** — A is the cause of element B ; A determines B. Here we set aside, within A, the potential distinction between the cause of a fact and a circumstance attending it. In both cases A is treated as a determining factor — a reduction that could prove problematic. Conflating the cause of a fact with the condition without which that fact could not exist risks becoming a dead end from the point of view of efficacy. But here we are seeking intelligibility first and foremost.
3. **B** $\rightarrow$ **A** — B determines A in return.
4. **A** $\leftrightarrow$ **B** — A and B are linked by a recursive relation. From mere observation of the pair (A, B) it is impossible to know whether A or B came first.
5. **(C (A$\leftrightarrow$B))** — A third element, C, determines A and B, and is in turn determined by A and B. The relation is fully distributive.
6. **[A, B, C, . . .]** — A, B, and C now form a complex system. The elements are linked through reciprocal interactions. The evolution of the system is unpredictable (the three-body rule). The

brackets in the expression [A, B, C, . . .] symbolize the system resulting from recursive causality. Remarkably, this complex system born of recursiveness also contains within itself a trace of the process that gave rise to it. The system arising from recursivity should therefore more properly be written :

7. **[A, B, C, [F(x)]]** — The inner brackets [F(x)] correspond to the internalization of the recursive function. In mathematics and computer programming, recursivity corresponds to a function that applies to itself, that folds back onto itself. Note that if A is removed, or disappears for whatever reason, B and C, having been determined by A, retain within their internal structure something of A. Expression (6) should thus more accurately be written :
8. **[ABC, BAC, CBA, [F(x)]]** — If A is removed, the system becomes :
9. **[BAC, CBA, [F(x)]]** — A remains present in the system in the form of traces embedded in the history of interactions among the determining elements. The expressions BA C and CB A signify that B and C carry the active traces (A as superscript) of element A, which influenced them but is no longer actual. Here — transposing to psychoanalysis — one can glimpse a possible way of thinking about mnemic traces : the original conditions of a trauma, whether real or phantasmatic, are no longer accessible in themselves, but they have left traces within psychic complexity.

Through this recursivity, a complex systemic entity is created. Recursive causality gives rise to new organizations, as Morin and Le Moigne make explicit : the principle of organizational recursion goes beyond the principle of feedback ; it supersedes the notion of regulation in favor of self-production and self-organization. It is a generative loop in which products and effects are themselves the producers and causes of what produces them. Human individuals produce society through and in their interactions, but society, as an emergent whole, in turn produces the humanity of these individuals by providing them with language and culture.[4]

Recursive causality is thus the generative engine of complex systems, whatever their scale and whatever substrate they are realized in. Climate, the immune system, the economy, international relations, ecosystems, and human societies are a few examples of such complex systems, which cannot be reduced to elementary constituents but which all possess, to varying degrees, properties that we shall briefly present.[5]

The Properties of Complexity

These complex systems are dynamic and evolve over time, without it being possible to gain complete intelligibility of their determinism. It is possible to make cross-sections through these systems and achieve local intelligibility confined to the sections examined, but global intelligibility of the system remains out of reach. These systems constitute shifting organizations, yet they also possess holistic stability. They reconstitute themselves despite the amputation (or neutralization) of constitutive elements — not only of their substrates but also of the factors that control them. Of course, this stability persists only within certain limits ; beyond these limits, if modifications to the substrate or to the control factors exceed certain critical values, the systems degrade and dissociate.

Complex systems are singular, since their evolutionary trajectories depend on variations in initial conditions. Because their history — subject to the vagaries of environment and chance — is necessarily singular, they are unique. They possess an internal structure composed of attractors, toward which their evolutionary trajectories converge or from which they diverge. These attractors can oppose one another, generating dynamic effects — as in meteorology, where zones of low and high pressure are competing attractors that generate atmospheric movement (winds).

While subject to the temporality of their evolution, these systems nonetheless escape the linear dimension of oriented time. Their emergence, and their reconstitution following perturbation, are determined by a recursivity that precludes any fixing of a "time zero" and any orientation of time's arrow. They therefore exist within a double temporality : one oriented toward the future of their evolution — generally

a slow dynamic — and one non-oriented, arising from their constitutive recursivity — generally a fast dynamic. Phenomena — that is, the apparent states these systems assume — are generated at the point where these two temporal dynamics meet.

Finally, one of the most remarkable properties concerns the internalization of the external dimensions within which a complex system evolves. An example of this internalization is found in meteorology : the appearance of a cloud — an object internal to the climatic system, a potential producer of rain, a modifier of luminosity, and so on — occurs along the front line between air masses of differing pressure and humidity. Yet barometric pressure and humidity are physical dimensions ; they are control factors that become internalized within the system in the form of internal objects (clouds). Another metaphor would be the trenches of the First World War, which became objects of the tactical system, concretizing in the substrate of the earth the immobilization of the front between opposing powers. Or, in history, the Berlin Wall separating East and West as the concretization, in physical reality, of an ideological opposition (capitalism/communism). This property — the internalization of a control dimension of a system — was described mathematically by René Thom. Control parameters become internalized within the system and turn into state variables.[6]

Thinking in Complexity

Thinking within complexity requires a triple mourning.

The first mourning concerns the abandonment of the notion of cause. That the history of ideas took so long to accept indeterminism attests to how deeply the cognitive necessity of cause is inscribed within us. Quantum physics put a definitive end to the illusion of a deterministic ontology of the real at the quantum scale. But at the scale of human thought, the necessity of thinking in terms of causality remains deeply resistant. This necessity may well be of biological origin. *Precurrence*, found throughout the animal kingdom, consists of an innate behavior of searching for the cause of a stimulus perceived by the organism.[7] In the human infant of a few months, the perception of a sound triggers a behavior of searching for the origin of the signal : the child first looks at its mother's face, then visually explores the environment in search of the source of the noise. To think an observable phenomenon without identifying its cause is cognitively difficult.

Yet complexity requires us to turn away from the first cause — in other words, from the origin. The history of ideas has already familiarized us with the necessity of this renunciation. Linguistics, for instance, constituted itself as a discipline by abandoning speculation about the origin of language.[8] Anthropology grudgingly tolerates reconstructions of the origin of humanity, but it established itself as a science by abandoning the myth of a single, identifiable origin. The human sciences that address the complexity of human phenomena unfold without needing knowledge of their origin. And yet thinking about origins remains a fundamental need — whether the origin of children, addressed by infantile sexual theories, or the origin of the universe, addressed by grandiose cosmological theories, not to mention the persistence of religious beliefs about the genesis of the world.

In complex systems, the question of origin is highly paradoxical. On the one hand, the origin of these systems most often escapes knowledge altogether ; on the other, initial conditions — external to the system — have a decisive and irremediable importance for the orientation of evolutionary trajectories. Every system carries its own historicity, without the originary moment of that history ever being establishable with certainty. If illusions are generated by unconscious desires, one of these is precisely the search for reassurance through an intelligible cause. Yet thinking a phenomenon without seeking its cause is exactly what complexity demands of us. The task is no longer to search for determining factors, whose recursive interactions prevent us from ever knowing the first moment, but rather to identify the trajectories taken by the system, and then to identify the attractors that influence them.

The second mourning is that of the intelligibility of totality. Complexity confronts us with systems of which we cannot acquire complete intelligibility. The only possibility available to us is a sectoral intelligibility. We cannot think the atmosphere in its to-

tality, nor societies, nor the immune system, nor the globalized economy, to take a few examples. We treat them as entities, we can manipulate them conceptually through abstraction, and we can study certain of their aspects in detail — but we cannot think them in their totality. This is not simply a matter of the number of elements, factors, variables, or dimensions involved, which can in themselves be considerable, but of the existence of dynamic interactions among all these elements, which at every moment generate unpredictable emergences of new objects.

Unlike a mechanical system, whose full set of possible states can be conceived, a complex system defies any totalizing conception and confronts human thought with a demand for humility. This does not, however, preclude reflection on the origin of these complex systems, on the identification of their attractors, and on their evolutionary trajectories. Discovering the critical zones in the evolution of these systems, the moments of bifurcation or fusion of attractors, and demonstrating their capacity for coupling between several complex systems — potentially of differing substrates — are among the possibilities available for thinking complexity.

The third mourning is that of the efficacy of action. A complex system deploys evolutionary trajectories that have a high probability of returning to states already traversed. Complexity is thus also, in essence, a return to the same. Any action aimed at steering such systems in one direction or another is therefore illusory. One can act on a complex system only by mastering the entire set of interacting recursive factors. This is possible in numerical simulation for artificial complex systems, since these can be embedded in a virtual space of higher dimensionality. It is impossible for "natural" complex systems, whose full set of dimensions is not even known.

This does not mean, however, that no action is possible ; paralysis is never a satisfactory option. Ideally, acting on a complex system requires "cooling" its entire evolutionary dynamic by attempting to act simultaneously on the whole set of factors. In practice, the only available option is often to make, sometimes intuitively, a cross-section through the complexity and to act upon it, hoping to have found the right angle of entry (an option mathematically modeled by Poincaré).[9] This places us in a purely empirical perspective. A second method consists of mathematical modeling in the form of systems of differential equations, and of establishing simulations of these systems' behavior, sometimes with remarkable results.

Finally, we should note the strong current tendency to predict a system's behavior through probabilities derived from the computational processing of massive data (Big Data) via formal "neural" networks.[10] Once it becomes possible to establish statistics on a gigantic mass of data, and thus to derive probabilities with a reduced margin of error, it becomes unnecessary to seek an understanding of how the system actually works. The black box can remain black, so long as, by analyzing its inputs and outputs, one can predict, more or less, what it will produce. Singular cases disappear before statistical reasoning. Action is then determined not by the intelligibility of the system, but by the probability derived from the statistical compilation of experiential data.

This list of "mournings" clarifies the current orientation of scientific tendencies, which aim at the pragmatism of prediction rather than at intelligibility. Complexity-based thinking is thus fragile in the face of demands for efficacy. The present tendency is to relegate it to the background, except in certain domains such as meteorology and, to a lesser degree, economics. It is possible that complexity has become an epistemological obstacle, in Bachelard's sense,[11] and that we are witnessing a regression under the sway of Big Data — the law of large numbers set against the particular case. The insignificance of the singular case, and pride of place to the blind law of large numbers !

Analyzing in Complexity

This presentation has been brief, but it suffices to introduce the interest that complexity theory holds for psychoanalysis. After all, this triple mourning — of cause, of totality, and of action — is one that psychoanalysis has long since worked through. To be sure, Freudian thought initially presents itself as a deterministic theory.[12] It arose from Freud's quest for a hidden cause behind hysterical symptoms that escaped all neurological explanation, since their so-

matic expressions did not correspond to the "territories" of neuronal innervation. But the first cause Freud discovered — traumatic sexual seduction, a linear cause-and-effect determinism — was abandoned once he discovered the phantasmatic nature of this seduction. Psychic causality then evolved into complexity. The cause no longer lies in a determining event but resides in the interaction between an event — sometimes major (real sexual seductions do also exist), sometimes trivial — and an unconscious originary phantasy, whose existence exceeds the individual.

According to Freud, this phantasy is inscribed within the phylogenetic past of the human species, following a Lamarckian process of transmission of acquired characteristics. This thesis of a transmission of originary phantasies, stemming from events lived by the primal horde, has generated a great deal of critical ink. At best it is regarded as the speculation of a scientist marked by the positivist knowledge of the nineteenth century, oblivious to the findings of contemporary anthropology. But the history of ideas never proceeds in a straight line. Lamarckian theses have never entirely disappeared from biological research ; today, genomic epigenesis has shown that the genome is not an impenetrable citadel against the environment.

Most important for our purposes is that the substitution of the phantasy thesis for that of real seduction places psychic causality within this double temporality : the temporality of the individual and the temporality of the human species. This has a practical correlate in the analytic cure : the necessity of isolating the analytic frame from social reality, so that statements have no other referent than that of psychic reality. Of course, this isolation is only ever tendential ; it can never be established in a constantly pure form. It meets limits — a limit set by an actual trauma experienced by the patient, of a social or somatic nature, requiring containment by the analyst ; and a limit met when analysis becomes frozen in banal, consensual rationalization, requiring active intervention to prevent this defense from inducing a "false-self" analysis. But beyond these circumstances, the technical isolation of the frame is constructed so as to rethink the question of psychic cause — no longer in terms of real traumas, but as the interaction, complex in the strong sense of the term, between events experienced over the course of a lifetime, particularly the initial conditions of childhood, and the originary phantasies embedded in individual psychic life.

Now, all these originary phantasies are bound up with sexuality. Freudian thought has always insisted on the exceptional nature of the sexual function within the human species. Of all the organism's functions, sexuality alone is not at the service of the individual, of homeostasis, or of individual life, but at the service of the species. There is thus a permanent conflict of interest between sexuality and the individual. This sexual function — existing as a continuous drive capable of changing its object, resistant to any organization or rationalization, and the source of the most intense pleasure in life (with the notable exception of the toxic pleasures of opiates and other drugs) — presents not only the singularity of being intrinsically reversible (it loops back on itself, returning to its own source, as in primitive auto-eroticism), but also exists within a complex double temporality : that of the life of the individual and that of the species.

The central axis of complexity in psychic life is thus given by the recursivity of the sexual drive, which is initially auto-erotic in its partial forms, then becomes capable of cathecting objects and returning to its source. The recursivity of the sexual drive is most clearly encountered in narcissism. The ego takes itself as its own object of love. In Freudian terms, the libido emitted by the protoplasmic ego returns upon itself — upon the emitting ego — generating transformative effects, ranging from narcissistic stasis (improperly termed "autistic") to the pain of an ego whose internal boundaries are under attack from narcissistic tension, to new cathexes intended to relieve this tension. In every case, the narcissistic recursivity onto the emitting ego generates a new configuration.

The self, resulting from the narcissistic cathexis of the ego, is admittedly not a Freudian agency, but it is a notion that is difficult to avoid. Some analysts have described it as a state of the ego (Heinz Kohut), while others (Béla Grunberger) grant it the full status of a psychic agency. By considering the narcissistic cathexis of the ego as a recursive process, one can better understand how the self may be an

emergent entity. Complexity theory familiarizes us with the possibility of stratified structures endowed with autonomy, whose interactions give rise to new organizational strata with unprecedented properties. The feedback of a system's outputs onto its own inputs (recurrence) generates the appearance of a self-representation — that is, of an agency of that system. This emergent agency contains a global representation of the underlying system, but it possesses new properties that are not deducible from the properties inherent to the system itself. A higher, unprecedented level of complexity emerges, one that is not reducible to the known constitutive elements of the system.

In systems-theoretic terms, the system self-finalizes by generating within itself an agency that is protected from its own inputs and outputs and capable of generating deductive inferences about its own functioning. This new agency sits at the summit of the system's evolution. It possesses new properties, but it also integrates a representation of the system's possible states. The evolutionary history of the system is encoded, in an unprecedented form, within this agency. It thus becomes possible to envisage a topology of complexity in which the self is considered a holistic agency emergent from the recursive cathexis of libido onto the ego.[13]

Narcissism would thus be necessary for the deployment of the complexity of psychic life, both for maintaining the individual's demarcation from its environment and for the exercise of cognition — since, as Daniel Widlöcher has emphasized, to think (cognition) a scene is always to represent oneself within that scene. As Widlöcher writes, thinking of someone always situates that person, that event, in relation to oneself — more precisely, in relation to a representation of oneself, since the two poles of the represented action are inseparable, and the targeted object, the situation evoked, define a partial self-representation, a self-representation-in-situation. When the scene evoked carries a positive or negative value, the self-representation may be regarded as the locus onto which the pleasure or displeasure generated by the represented scene is projected ; depending on the case, object-cathexis or narcissistic cathexis will predominate.[14]

This recursivity is also present at the unconscious level of relations with internal objects. It was Wilfred Bion who described this recursive function most clearly, even though he does not use the term itself. Bion's conception is of great importance for analytic clinical practice, but it is also a remarkable psychoanalytic theory of knowledge. Bion's references to the philosophy of knowledge — particularly Kant and Hume — are numerous and reflect a constant epistemological concern.

Bion's conception can indeed be related to Kant's transcendental idealism, through the existence of what might be called psychic noumena and their upward movement toward knowledge, which Bion terms K (the insight of coming-to-know), potentially moving toward transformations in O — the position of the unknown, the only position available to the analyst, whose listening must tend toward this limit point, this infinity from which one may approach the psychic reality of the patient. Bion is here very close to Kant, for whom nothing can appear as an object except what is formed by the a priori principles of sensibility and of pure understanding. The world of our experience is the world of phenomena ; it obeys the laws of our understanding. Things-in-themselves, noumena, remain unknowable. Bion's point O is comparable to what Kant calls the *focus imaginarius* — the point which, though not itself real, is nonetheless the locus from which the unconditioned can be thought, though not known.

As Kant argues, transcendental Ideas are never of constitutive use — they do not give us the concepts of any actual objects, and understood in that way they would be mere ratiocinative (dialectical) concepts. Rather, they have an excellent and indispensably necessary regulative use : that of orienting the understanding toward a certain goal, toward which the guiding lines of all its rules converge at a point which, though merely an Idea (a *focus imaginarius*) — a point from which the concepts of the understanding do not actually originate, situated as it is wholly outside the bounds of possible experience — nonetheless serves to give these concepts their greatest extension together with their greatest unity.[15]

Bion's theory can also be related to Edmund Husserl's phenomenology. For Husserl, the data of per-

ception — what he calls *Data* — are disjointed elements that can only be unified in representation once they have been seized by the "ray" of intention. Intentionality synthesizes the disjointed sketches (*Abschattungen*) arising from perceptual experience.[16] The identification of the object, which Husserl calls logical synthesis, is subject to an experience of the flow of these successive sketches.

Husserl's conception is, on this point, very close to Bion's, in which the alpha function unifies the beta elements arising from experience — whether perceptual or drive-related — that are unassimilable by the ego, by transforming them into alpha elements. As Bion describes it, the alpha function is the function by which sense impressions are transformed into elements capable of being stored, so that they may later be used in dream-thoughts or in other kinds of thinking.[17]

Beta elements are the raw elements of perceptual experience — *membra disjecta*, unintegrable as such within psychic space — which must undergo transformation, becoming alpha elements through the alpha function, whose model is maternal reverie. Beta elements become alpha entities linked by a recursive relation, generating psychic structures such as, for Bion, the conscious/unconscious interface. But — and this is the crucial point — the alpha function, initially exercised by the mother (the breast), becomes internalized recursively.[18] The infant introjects not only the alpha elements but also the alpha function itself, which then enables it to metabolize the elements of its own lived experience.[19]

If we attempt to formalize this recursivity, we obtain the following statements. Let β be the raw data of exogenous (distal) perception and of endogenous perception (bodily sensations), both unassimilable.

$\mathbf{F}(\alpha) \rightarrow \beta \rightarrow (\alpha - \beta)$ — The alpha function (maternal reverie, the analyst's listening) is brought to bear on the beta elements and binds them into alpha-beta elements. The transformation continues by creating an entity that recursively encompasses the alpha function itself. The transformation then yields :

$[(\mathbf{F}(\alpha)(\alpha - \beta)]$ — the brackets [and] signifying the creation of a psychic entity (a contact-barrier, ego growth, and so on).

Bion describes two mechanisms in this transformative process :

1. **The container/contained mechanism.** Parts of the self, of sensory origin, psychically unassimilable, are projected into a containing object which is subsequently introjected. The analytic setting thus constitutes the equivalent of the maternal self.

2. **The relation between the Kleinian positions PS $\Leftrightarrow$ D** is conceived as a permanent dynamic interactional process, allowing the transformation of dispersed, unlinked elements into linked elements once the depressive position has been worked through. This transformation results from the relinquishing of certain sensory qualities of objects — it is through this process that symbols are created.

Bion's conceptions are sometimes disconcerting in their formalism, and one may reasonably be circumspect about the practicability of his notational system within clinical analysis. Nonetheless, his theory of the introjection of the alpha function, together with his account of the capacity to create containing psychic structures (contact-barriers, the conscious/unconscious interface), is remarkably congruent with models of intelligibility drawn from complexity theory. Bion's thought is certainly a necessary link toward an intelligent commensurability between psychoanalysis and the contemporary scientific environment. As Bion writes, the difficulties experienced by a patient suffering from a disturbance of thought are no different from those encountered by scientists and by all those concerned with the establishment of facts : these difficulties result from a failure to ascertain the facts, and thus require inquiry into the nature of that failure. The patient's failure clearly originates from within the personality. Psychoanalysis of this failure is impossible without understanding the problem faced by the philosopher of science ; conversely, the latter's problem is incomprehensible without psychoanalytic experience of disturbances of thought.[20]

Dreaming in Complexity

Analyzing within the complexity paradigm allows us to reframe certain issues that have traditionally divided psychoanalysis and science. Let us accept the (Lamarckian) idea that the evolution of living organisms tends toward increasing complexification. The mental system is the ultimate phase of the evolution of complexity along one of the various evolutionary lines of life. This does not mean that the complexity of a somatic organ, or even an organelle, is any less complex than that of the mind — there exists a prodigious complexity at every level of the living. But the progressive integration of organic functions over the course of evolution entails the necessity of developing regulatory systems, whose integration in turn drives the development of mental functions.

We hold that psychic life is implemented within the complexity of dynamic neuronal systems.[21] It is an emergent property of that system, but it is also, in itself, a complex structure. Psychology, psychoanalysis, cognitive science, and neuroscience each carve out local sections within the complexity of this system and each achieve a sectoral intelligibility. Cognitive science identifies the stable forms of cognitive processing (information-processing modules) ; neuroscience seeks to describe the implementation of these modules within neuronal structures ; psychoanalysis aims to explain the meaning of conduct, object relations, and the significance of phantasies, dreams, and parapraxes. Epistemologically, these disciplines are vectors of approach, each achieving its own sector of rationality.

We shall take dreaming as our example. For Freud, the dream is the guardian of sleep. It performs this function by representing the wishes of the waking day as already fulfilled. Because censorship persists during sleep, and because wishes are drawn toward repressed sexual material, wish-representations undergo a distortion intended to render them opaque to the dreamer's ego. Condensation and displacement are the principal mechanisms of this processing. The "text" of the dream appears absurd because wish-representations have been disguised, but it is not the haphazard product of an altered neurophysiological functioning — it is the product of a genuine psychic function.

For Bion, the failure of the alpha function means that the patient cannot dream, and therefore cannot sleep.[22] A successful dream is, precisely, a forgotten dream. For Freud, the dream protects the sleep the organism requires, through the hallucinatory fulfillment of wishes — deformed by censorship and secondarily reworked in the manifest content. These unconscious wishes of the waking day are drawn toward repressed sexual wishes, which explains the over-representation of sexual content and genital organs, disguised in symbolic form. Finally, the Freudian dream occupies a singular position with respect to time, since it contains wish-representations arising from the individual's past, as well as symbols that Freud associates with the phylogenetic past of the human species. By presenting the wish as fulfilled, it anticipates the future in a certain sense.[23]

For neurobiology, the essential function of dreaming is that of a mental activity necessary for the maintenance of neuronal networks through the reactivation of episodic memory during sleep.[24] The phylogeny of sleep states demonstrates that all sleep states serve a functional purpose.[25] The four sleep states — drowsiness, light slow-wave sleep, deep slow-wave sleep, and paradoxical (REM) sleep — recapitulate the adaptive responses of organisms over the course of evolution. Emergence from the aquatic environment and the new condition of gravity imposed muscular hypotonia during sleep on vertebrate organisms. Homeothermy in birds and mammals conferred an adaptive advantage by enabling colonization of the globe beyond tropical zones, but it required permanent motor activation, with a high risk of exhaustion. The nervous system adapted through deep slow-wave sleep, which reduces glucose and oxygen consumption in the brain ; slow-wave sleep thus facilitates restorative processes.

But because the nervous system is slowed during deep sleep, there is a risk of synaptic deafferentation and hence a loss of experiences acquired by the individual, which generated new synaptic connections during waking life. To limit this risk, evolution developed paradoxical (REM) sleep, which reactivates synaptic functions under conditions of sensory isolation

and motor paralysis. Human sleep recapitulates these various evolutionary moments, but curiously their acquisition in the child follows the reverse order : from fetus to human adult, the various constraints appear in the reverse order of species evolution — the circadian rhythm appears after REM sleep and slow-wave sleep.

The phylogeny of sleep is, in any case, explicit : the full set of sleep phases constitutes a necessary recapitulation of adaptations. Dreaming occupies a remarkably distinctive position between the dimension of the individual — their lifetime experience — and the dimension of the species. Dreaming ensures the renewal of individuation by maintaining variability among individuals within a population, stabilizing their idiosyncratic experiences through visualization in episodic memory ; this is why visual experience predominates in dreams. Dreaming maintains inter-individual difference, since experiences relived in episodic memory are distinct for every individual. Yet at the same time, dreaming recapitulates the evolution of the species and maintains instinctive behaviors : decorticated cats, stripped of their motor-inhibiting structures, display hunting behavior during dreaming but, according to Jouvet, not lordosis, which is evocative of mating behavior.[26]

The periodic occurrence of REM sleep — and thus of dreaming — would thereby counteract the idiosyncratic effects of daytime life (that is, the individual's lived experience) while permitting the conservation of genetic characteristics. The PGO waves (pontogeniculo-occipital), discovered by Marc Jeannerod in 1963, would be the carriers of these mechanisms of genetic reactivation. However, the equation of REM sleep with dreaming has since been called into question by the discovery of dream-like moments during deep sleep, owing to the activation of certain cortical areas similar to those activated during REM sleep.[27]

Let us now consider psychic life as the unfolding of the evolutionary complexity of organisms. It is marked both by the permanent recursivity of its functions — each capable of calling upon itself — and by a double temporality, that of the individual and that of the species. From this perspective, the neurobiological thesis of dreaming is not in contradiction with Freudian theory. The dream may be necessary for the maintenance of neuronal networks while at the same time serving the fulfillment of unconscious wishes, all while preserving slow-wave sleep and its functional restorative processes.

The dream of the REM phase — the most recent development in evolutionary complexity — may thus serve the fulfillment of unconscious wishes (Freud), serve the maintenance of psychic individuation through the self (Jouvet), and protect the deep sleep necessary for the organism's somatic recovery. What psychoanalysis contributes is the singularity of the sexual within the dream. In the human species, the sexual drive invests, and subverts, the neurocognitive processes of dreaming. The manifest content of the dream results from distortions imposed on the latent content of repressed wishes, and this latent content is scaffolded upon the neurobiological processes of neuronal reactivation.

At bottom, dreaming presents us with a situation analogous to that of sucking, with the sexual drive's anaclisis (*Anlehnung*) onto the oral function — a relation on which Jean Laplanche insisted in his account of the relationship between the sexual and what he calls self-adaptive mechanisms, that is, in other words, neurocognitive functions.[28] The sexual leans upon the non-sexual, and what holds true for somatic functions holds equally for dreaming. The presence of trans-individual symbols in dreams — alongside purely idiosyncratic elements — is thus congruent with the double neurobiological function of dreaming : ensuring the maintenance of instinctive life and the acquisitions of the individual.

For animal organisms since birds, dreaming is a physiological function selected by evolution for its capacity to reconcile the individual acquisitions of daytime experience with the phylogenetic acquisitions of instinct. In humans, whose sexual function has undergone a particular evolution, the dream is sexualized and expresses both the repressed wishes of the day (latent content) and the phylogenetic organizers of humanity (the incest taboo, Oedipal desire, the prohibition of cannibalism), expressed through originary phantasies present in a disguised form, transformed by censorship, within dreams.

Conclusions

We have only touched upon certain possible perspectives on complexity in psychoanalysis ; other dimensions could be explored. For example, a rapprochement between the three dimensions of Freudian metapsychology and the dimensions of complexity theory could prove a fruitful perspective. The economic dimension, whose preferred metaphorical field is financial — cathexes of desire, withdrawals, expenditures, and counter-cathexes — corresponds to the energetic dimension of complex systems, which consume, produce, and invest energy in order to maintain themselves, develop, and interact with other systems. The dynamic dimension, whose most explicit metaphorical field is hydrology — the science of flows and continuous pressures — could be related to the continuous, irrepressible character of the sexual drive, which determines the trajectories of desire. The topical dimension, composed of agencies in interaction, evokes attractors whose constant competition creates the trajectories of psychic life that constitute mental states.

These are only suggestive rapprochements, but the overall vision of the late Freud — that of the *Outline of Psychoanalysis* (1939) — is indeed a bold conception of complexity, in which the two distinct temporal dimensions within which the individual, the species, and culture move are both present. As Freud writes, the external world in which the individual finds himself exposed after separating from his parents represents the power of the present ; the id, with its inherited tendencies, represents the organic past ; and the superego, added later, represents above all the cultural past, which the child must, so to speak, relive in the course of the early years of life. And further, in a striking conclusion, Freud observes that part of what is culturally acquired has undoubtedly left its precipitate in the id — much of what the child lives through anew will carry a reinforced effect, because it repeats a very ancient phylogenetic life-experience ("What thou hast inherited from thy fathers, acquire it to make it thine own"). The superego thus occupies an intermediate position between the id and the external world, uniting within itself the influences of present and past. In the establishment of the superego, one witnesses, so to speak, an example of how the present is transposed into the past.[29]

Three dimensions in recursive interaction — biology (the organic past), culture, and external reality ; a double temporality, that of the species (phylogenesis) and that of the individual ; the internalization of external dimensions ; the decisive importance of initial conditions (childhood) — Freudian thought lies at the very heart of the complexity of the human condition. As such, it deserves a central place that neurobiology and cognitive science today deny it.

We would therefore like to conclude with a tribute to the analytic method itself — the cure, free association, and the analysis of the transference. As the sole vector for penetrating the complexity of psychic life, the rupture of dyadic communication effected by the analytic setting induces a recursive process. Speech folds back upon itself. Words, turns of phrase, silences, and expressions return and produce emergent effects — regression, certainly, born of the frustration of the unconscious demand addressed to the analyst, but also the emergence of new thoughts, new attitudes, and new phantasies that weave the analysand's discourse.

This recursivity also exists on the broader scale of the temporal dynamics of the cure. Lacan schematized these moments in which the subject's speech returns upon its own trace, thereby rediscovering the existential question defined by its structure — death, sexuation — recursive moments that are, at times, propitious for interpretation.[30] The analytic cure could thus be requalified as a device oriented toward the deployment of recursive complexity, designed to initiate a dynamic of change in subjective trajectories.

This is not merely a matter of definition. In the current crisis facing psychoanalysis within the present context of the history of ideas, what is at stake is the attempt to defend the congruence of psychoanalysis with the contemporary epistemic field — as was the case for Freudian thought at the time of its creation and dissemination — while holding firm to what constitutes its radical singularity : the constant subversion of the individual by the sexual drive.

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Notes

[1] : Morin, E. (1977–2004). *La Méthode*, vol. 1. Paris : Le Seuil, p. 112.

[2] : Henri Poincaré (1854–1912) published in 1890 the paper "Sur le problème des trois corps et les équations de la dynamique." In a three-body system, solutions appear that are highly sensitive to initial conditions, for which an analytic solution is illusory.

[3] : Kant, E. *Critique de la raison pure*, 1781, PUF, 11th ed., 1986, pp. 97–98.

[4] : Morin, E., & Le Moigne, J.-L. (1999). *L'intelligence de la complexité*. Paris : L'Harmattan.

[5] : On the example of the immune system, see Varela, F. J. (1989). *Autonomie et Connaissance, essai sur le vivant*. Paris : Seuil.

[6] : See Thom, R. (1966/1980). *Modèles mathématiques de la morphogenèse*. Paris : Christian Bourgois ; and Virole, B., "Présence de René Thom," www.benoitvirole.fr.

[7] : Precurrence was defined by the eminent biologist Sherrington : the perception of a cue for an object triggers anticipatory behavior regarding that object. Sherrington, C. (1906/1952). *The Integrative Action of the Nervous System*. Cambridge : Cambridge University Press.

[8] : The Société de linguistique de Paris, founded in 1864, explicitly excluded from its charter any research on the origin of language.

[9] : See Manneville, P. (1991). *Structures dissipatives, chaos et turbulence*. Saclay : Aléas, p. 11.

[10] : Artificial intelligence systems use layers of logical computing units simulating the functioning of biological neurons.

[11] : For Bachelard, scientific knowledge must overcome the following obstacles : first-hand experience, general knowledge, the excessive extension of familiar images, unitary and pragmatic knowledge, the substantialist obstacle, and the animist obstacle. Bachelard, G. (1934). *Le Nouvel Esprit scientifique*. Paris : Alcan.

[12] : For an epistemological interpretation of Freud's work, see Sulloway, F. J. (1979/1981). *Freud, biologiste de l'esprit*. Paris : Fayard.

[13] : See Virole, B., *Topique de la complexité*, www.benoitvirole.fr.

[14] : Widlöcher, D., "La relation narcissique," *Traité de psychopathologie*, PUF, 1994, p. 431.

[15] : Kant, E. *Critique de la raison pure*, PUF, 1986, p. 453.

[16] : Husserl, E. *Idées directrices pour une phénoménologie* (P. Ricœur, Trans.). Paris : Gallimard, 1950.

[17] : Bion, W. *Éléments de la psychanalyse*, 1963, PUF, 1979, p. 12.

[18] : For François Richard, it represents both the object and the instrument of psychic investigation. See his foreword to Bion, W., *Aux sources de l'expérience*, 1962, PUF, 1979, p. 5.

[19] : Bion, W. *Éléments de la psychanalyse*, 1963, PUF, 1979, p. 37.

[20] : Bion, W. R. *Aux sources de l'expérience*, 1962, PUF, 1979, p. 85.

[21] : On this point, see the pioneering article by André Bourguignon, "Articulation de la complexité du système nerveux central et de la complexité de l'organisation psychique," in *Les théories de la complexité, autour de l'œuvre d'Henri Atlan* (Colloque de Cerisy, F. Fogelman Soulié, Ed.), Seuil, 1991.

[22] : Bion, W. *Aux sources de l'expérience*, 1962, PUF, 1979, p. 33.

[23] : See the final paragraph of *The Interpretation of Dreams* (1900), PUF, 1967 : Freud there notes that the ancient belief in prophetic dreams is not entirely without foundation — the dream leads us into the future in the sense of showing us our wishes fulfilled, but this future, present for the dreamer, is shaped by an indestructible wish in the image of the past.

[24] : Jouvet, M. (1986). "Programmation génétique itérative et sommeil paradoxal." *Confrontations psychiatriques*, No. 27. On the history of the discovery of REM sleep (1959) and neurobiological conceptions of dreaming, see Debru, C. (2004). "Le rêve : aspects épistémologiques." *Revue philosophique de la France et de l'étranger*, 129(3), 331–337.

[25] : Jouvet, M. (1965). *Neurophysiologie des états de sommeil*. Paris : CNRS ; and Poirier, R. (2010). *Phylogénie et ontogénie du sommeil*. Institut Danone.

[26] : One may see here a notable difference in perspective on sexuality between neurobiology and psychoanalysis : for neurobiology, only behavior oriented toward the reproductive act is sexual, whereas for psychoanalysis sexuality cathects — one might say percolates into — non-genital objects as well.

[27] : Debru, C. (2004). "Le rêve : aspects épistémologiques." *Revue philosophique de la France et de l'étranger*, 129(3), 337.

[28] : Laplanche, J. (1987). *Nouveaux fondements pour la psychanalyse*. Paris : PUF.

[29] : Freud, S. *Abrégé de psychanalyse*, 1939, *Œuvres complètes*, vol. XX, PUF, 2010, p. 305.

[30] : "What I seek in speech is the response of the other. What constitutes me as subject is my question." Lacan, J. *Écrits*. Paris : Le Seuil, 1966, p. 271.

Translator's note : This is a scientific English translation of the French original by Benoît Virole. Kantian, Husserlian, and Bionian passages have been freshly rendered from the French text rather than reprodu-

ced from existing published English translations, in order to preserve fidelity to Virole's own French rendering and citation choices. Key technical terms of psychoanalysis (Kleinian positions PS/D, alpha/beta elements, container/contained) and of complexity/dynamical-systems theory (attractor, bifurcation, recursivity, structural stability) follow standard English usage in each field.