# VI - The Organism and the Operational Situation

Last chapter we developed a notion of life as comprising nonsystematic wholes. Evolutionary gradients included the constraint of the inner and outer environments via development and learning and culture, for example, and the emergence of more flexible and varied performances. We found the non-systematic to be intrinsic to life. One of the evolutionary pressures for this is not hard to discern. Living beings find themselves in non-systematic sets of situations. Thus, to look at a living being simply as a unity is too abstract. It needs to be understood in its environment since the performances of animals and the biological and psychological processes that support them are in relation to elements in the environment. This is not to understand another kind of whole since we are considering the relations of things to one another. Yet as noted, there is a sense in which the organic whole can only be understood in its relations to what it is not since its existence relies upon them. These relations do not comprise an infinite set. Living things have a life cycle of recurrent operations and live their lives in the context to which those can be related. An animal and its habitat are co-related. Presenting a model for understanding that is our initial concern. Showing how that model can be used to understand human living, or being in a world transcending the immediate situation, is our second concern which we will address in the final chapter. This will be a key step in correlating the natural and the human sciences.

## The Non-Systematic Whole

In a whole that is not fully systematic, everything is not related to everything else, but everything is related to something that is related to something else, so that all the parts do not need to be interrelated. This permits an aggregate of elements and occurrences that in turn constitutes the potency of the whole to perform in relation to itself and to the other and to develop. Remotely it makes evolution possible. In such a whole it is possible to have structure and systematic processes without the whole being fully systematic. This permits organisms to live in situations which are not fully systematic. It also provides evolutionary gradients towards greater complexity, greater variability and greater flexibility.

This type of whole is not a system nor is it a set of fixed processes. Neither is it a structure where changes in one area necessarily have implications that radiate throughout the whole, though this can occur. This is because not all parts of the whole need to be engaged at any one time for it to function. Understanding such a whole takes us beyond determinism, systems theory and structuralism. Our contention is that organisms are such wholes. Organisms need to be understood holistically, as spontaneously integrating their parts in their behavior or performance, but these integrations are transient and not necessarily related to one another systematically. Neither are parts necessarily related to particular processes. Hierarchy theory, a variant of systems theory, with its notion of levels of organization can introduce unwarranted difficulties into understanding organisms.

With more complex organisms mutually self-mediating systems have evolved to support more flexible and complex behavior.

> The respiratory system supplies fresh oxygen not merely to the lungs, but to the whole body. The digestive system supplies nutrition not merely to the digestive tract but to the whole body. The nervous system supplies control not merely to the nervous system but to the whole body. And the muscles supply locomotion not merely to the muscles but to the whole body. The result is something that has fresh oxygen and is nourished, is under control and is moving, because you have a number of immediate centers ….and the centers make the whole, giving the whole all the properties of each of the centers of immediacy. [1]

The notion of mutual self-mediation is holistic. Since the systems yield different states at different times in different situations they are understood statistically as well as in terms of their core sets of possible interrelations.

Lonergan distinguishes primary and secondary determinations. Loosely put, primary determinations are basic relationships. Secondary determinations regard the way the relationships occur. The concrete occurrences have variations for which the primary relationships as abstract do not account. So we can have a scientific model of how satellites orbit a body in space which provides the primary relationships, but the actual orbits of distinct bodies vary from the model. These variances provide the secondary relationships. There is no model which accounts systematically for the variances. The existence of the satellites and the events of their orbits are understood statistically.

[1] Bernard Lonergan, "The Mediation of Christ in Prayer" in Philosophical and Theological Papers 1958-1964 , (Toronto: University of Toronto Press, 1996), p. 165.

If we consider an organism the situation is more complex. With mutually self-mediating systems not only do we have the case of the secondary determinations of the systems, but we need to address the interrelationships of the systems to one another. The divergence of the systems from the systematic can yield various states within a range that constitutes species specific behavior. So we can have flexible sets of schemes of recurrence that define the behavioral range of ducks and coyotes, for example.

In the higher organisms' behavior cycles, not only do we have the different motivational cycles such as those associated with mating, eating and play, but we have the diurnal cycles of sleeping and waking. Within sleep we have other cycles such as deep sleep and REM sleep which are not fully understood. As persons we typically assume that our freedom is the primary operator in determining what we do, at least in the immediate situation. However, if we acknowledge that we perform within a context, the context can be invoked either via our free operations or other sources. The person may think that the context is set by the "objective situation" but that situation as an operational situation is mediated organically and consciously. The other sources can be either conscious or non-conscious.

If we consider the fight or flight response, the source is conscious. There is a perceived threat. All major systems are transformed via a stereotypical response which enables both fight or flight. Which is invoked depends on the animal's decision. The fact that either is possible, points to the openness of the organism's state and indicates that self actualization, this time through decision, is what completes the process. This is a basic tenet of Kurt Goldstein's holism. The organism is structured for self actualization. It spontaneously organizes itself as a whole engaged in performances that constitute what it is. Polanyi terms these comprehensive acts. For

Lonergan these would include the conjugate forms of behavior that distinguish one species from another.

In the fight or flight situation, both the key operator of performance and the operator that invokes the context for performance are conscious. This is not always the case. For example, events in the immune system can influence mood via peptides which are utilized throughout the body. Their somatic release can activate neural activity via the pituitary pathway which bypasses the blood-brain barrier so that emotions can have visceral as well as neural origins. When we are ill or injured our mood may become depressed and we become less active.

Falling asleep is another type of case for here our fundamental state changes from full consciousness to the states of the sleep cycle. One theory of sleep is that it permits "restorative" functions to occur by permitting neural networks to process independently of the wider context and correlative integrations required for conscious performance. The organism is still a whole, but not fully integrated as it proceeds through the different cyclic stages of sleep. The operations that lead to us falling asleep and waking up are not conscious. The fact that consciousness does not initiate itself leads to the understanding that consciousness per se is not free, rather freedom is conscious.

In mammals, what we have are non-systematic wholes where at one time one mode of behavior is predominant and at another time, another mode, and they do not need to be interrelated other than that they are activities of the same thing. Likewise, there can be different types of states while awake where self-actualization is possible and while asleep where it is not. In these cases different systems become dominant to set the context for performance or non-performance.

In this holistic view the major systems are complementary with sometimes one taking more of a leading role and sometimes another. For example, though the neural system provides a different means of integration of operations than biochemically based systems, it utilizes the biochemical for neural transmission and can itself be subject to biochemical regulation that influences the organism's behavior. In short, there are complex interactions across the mutually self mediating systems that are literally parts of the comprehensive processes or sets of conjugates that constitute behavior.

The notion of "part" in the distinction of wholes and parts is suggestive, for a part, as a part of a process, is functional. It does something, and the something that it does can be distinct from the nature of the part itself. If we turn to understanding parts, we can see that there can be a independence of function from how it is realized. The same thing can be done in different ways. Likewise, the same thing or part can be used in different ways. The first is expressed in the system notion of equifinality and the latter in the notion of equipotentiality. Thus, it is possible that both grey parrots and chimpanzees have insights, yet they are not animals of the same class. We have a convergence of a type of form from divergent sources. This is an instance of equifinality. On the other hand, nails, like atoms or neurons, can be used within a variety of structures. This is an illustration of equipotentiality. The potential for manifolds to be organized into different organizations yielding different kinds of things rests on equipotentiality. We see equipotentiality within the organism in the variety of coordinated actions of populations on other populations that yield disparate behaviors.

This view is in contrast to that of hierarchical organizations where lower levels of organization are themselves organized into higher levels where the higher levels, as organizations of the lower, are more complex. What relations obtain among the levels? This is where the key philosophical discussion and difference occur. If the higher organizes the lower, then the relation is of organizer to organized. Higher level principles of organization are postulated which can cause changes on lower levels of organization. We can conceive of "above downward" causality for example. Conversely there is "below upwards" causality. There are at least three instances. The first is the most straightforward where the higher organization is what it is because of the parts that make it up. The higher can be explained reductively in terms of the lower. Levels of computer languages in their instantiation in a machine can be understood this way. (Use of computer languages cannot be. But that is a more complex discussion for another day.) Higher level languages organize lower level commands in general tasks which can be fully articulated in both languages. It is just that the lower language is more cumbersome. Likewise, the notion of theoretic reduction trades on the same relationships. It is granted that chemistry and biology are necessary today to understand organisms, but that is only because physics is underdeveloped. Once physics is mature, it will be able to explain everything. This type of reductionism is materialistic.

The model of levels of organization is also used as a context for the mind-body, matter-spirit, and brain-consciousness discussions. Is the mind the brain? The answer is "No" if they are different levels of organization and the mind is a higher level. The mind may not be distinct from the brain but it is something more. The answer is "Yes" if they are not different levels. Identity theory, interactionism, psycho-physical parallelism and other mind-brain theories all can be cast in terms of hierarchy theory.

The discussion of levels can be ontological where chemicals organize physical particles, biological processes organize chemicals, organs organize cells, etc up the ontological ladder. When we turn to the understanding of organizations it is tempting to see them as hierarchically organized because of the way we understand them. There are two fundamental pitfalls. The first is imaging a hierarchy as a series of levels. The second is the fact that we understand them in each of the sciences abstractly. If we do not recognize these errors we are prone to not understand the organism and ourselves as wholes. Now it is true that one argument against reductionism is based on understand chemicals as organizations which follow but transcend physical principles and so on up the ladder of complexity. While understanding can progress from physics to psychology, for example, we cannot do the reverse since our insights moving up the ladder are integrations of prior insights. We do not end the process to get the same insights we had at the beginning or by translating each level into its equivalent on the preceding level. Rather there is a progression in the development of intelligibility. Even if we had fully developed explanatory sciences and understood the fundamental terms and relations of the sciences in this manner, it would not follow that organizations in nature followed the same strategy as this cognitive process. There are some wholes, structures and systems that can be understood in this way, but do not function this way. Understanding can proceed by analysis and synthesis, but organisms do not. They are wholes throughout their existence. While some parts may go away during development or be taken away during the life cycle and the organism can adapt, there is some point in all organisms where if certain processes are compromised, the organism dies. Likewise, the organism as the initial auto-organizing entity is a whole. It is not made a whole out of parts, but becomes a whole through the introduction of the remaining conditions for being one through sexual reproduction or by the splitting of uninterrupted full processing in mitosis. They may exploit hierarchical organizational principles in their performance, but it does not follow that they are hierarchical organizations themselves.

This is important because, if properly understood, it transposes the understanding of mind and body, for example, to understanding different aspects of the same thing versus trying to find relationships between two different parts of one thing that are quite different in kind. It also eliminates the tendency to imagine mind and body as two different things that need to be related. The notion of *levels* of organization imports a spatial metaphor that can be limiting. Rather we need to think of contexts of organization. Combined with the notion of evolutionary differentiation as the introduction of greater complexity within wholes the project of understanding becomes one of grasping the organization of performance as a whole rather than deconstructing the organism and then attempting the impossible task of putting it back together again.

The ontology of the organism evolved. It did not evolve from "below upwards", but holistically via "internal" evolutionary differentiation. Evolution occurred within wholes, as does development. The ontology of organisms, then, becomes one of the types of parts that evolved and survived and their manner of organization. With major moves, such as the evolution of the neuron and the associated emergence of consciousness, new potencies arose. The shift from expression to sign with the concomitant biological and psychological changes is another instance. The ontology of parts makes bioengineering easier to understand.

The holistic view provides a reformulation of the binding problem. This is the issue in cognitive science of understanding how the various neural areas involved in seeing, for example, are integrated in their functioning to enable a unified visual field. On the holistic view we can conceive of neural development as differentiation of function within a whole via the development of different types of neurons, pathways, etc. The hypothesis is that the field was never not integrated. It always was a unity. What occurs in development is that new differentiations emerge as in the development of the ability to see horizontal and vertical lines at a certain period of visual development. The same is true in general of mind and body.

There is a "binding problem" in development where there is divergence of major lines of development early on that need to be integrated later. The development of muscles and their integration with the neural network to actualize the motor system is a case in point. Again, this occurs within a whole and is the emergence of new capabilities for the organism. The task at this point becomes one of understanding the various modes of integration. For example, there are integrations of conscious operations that occur via insight. There are integrations of the motor system that occur via the attachment of neurons to muscle fibers.

Lonergan distinguishes adequate and inadequate distinctions. One thing is distinct from another, as John is distinct from his father, for example. That distinction is adequate. But John is not adequately distinct from his arm. We would not say that John is his arm. The distinction is inadequate.

In general, processes and their components are in the relation of organization to organized. Further, processses are temporal wholes where there is a unity of process over time. The process has parts. The parts and the whole are a single organization. [2] Though they can be

[2] This single organization is extremely complex. The introduction of hierarchy theory is one means of handling the complexity by distinguishing levels. While there can be organizations of organizations … of organizations, concretely there is only one organization with the sub-organizations inadequately distinguished. Imagination is not up to the task and we must resort to concepts and virtual images. The notion of nested contexts is one helpful notion as is the symbolization of a mathematical equation with expressions within expressions. But in a complex

distinguished, that distinction is inadequate. When considered in isolation, one can err and consider the part as fully distinct from the whole, which is what the reductionist does, at least tacitly. On the other hand, if we consider how the components survive or endure, they either survive as part of a process or as sometimes independent of any process so they can be organized into another process. If they survive as part of a process, then there is not a higher and lower level of organization but simply an organization of parts where the parts are inadequately distinct from the organization. Notionally we can distinguish them, but concretely they are a whole. If they exist for a time independently of any process then we have an instance of the non-systematic nature of the whole where there is potency for further integration.

The discussion of higher and lower is carried over to higher and lower systems, specifically the organic, the neural, the psychic and the conscious. The key here is to acknowledge that these exhibit mutual self mediation insofar as processes are distinct and are inadequately distinct insofar as there are organizations of organizations. Failure to do so results in issues in the relation of mind and body which can never be resolved if they are considered adequately distinct. Likewise, the reductionist can never reassemble the organism from its disaggregated parts without implicitly reintroducing the organization he or she denies. So the "visual content as seen" integrates wavelengths of light, neural transmitters, neural dynamics and consciousness at a minimum. An integration of multiple types of systematic processes is required to understand it.

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neurodynamic process these would be inadequate given the reciprocal relations and transformations occurring across neuronal groups. The bottom line is that nothing suffices except the understanding itself. However, in most cases it has not been achieved and we are left hanging – or we fill it in with a metaphor or something else that is simpler which is where we make our mistake.

Also, consciousness is not always the operative integration, so it is not always the "highest" integration. We noted that different systems play different roles at different times where, as in sleep, the organic and the neural may take precedence over consciousness. However, if one considers the comprehensive acts and performances of an organism, it is the performative integration that comprises the relations that differentiate species from one another.

Our contention is that the organism is a non-systematic whole, not a hierarchical system. There are multiple systematic integrations within the whole. While these may be understood in terms of organic, psychic and conscious functioning, these are inadequately distinct and are not fully systematic. In the lower organisms, including the less complex mammals, we find fairly regular motivational cycles and behaviors that actualize them. The non-systematic in these cases approaches the minimal flexibility immanent in the secondary determinations of primary relations where the primary relations are understood as comprising a fairly invariant development and fairly stable developmental stages and life cycles. In humans, though, we find a major flexibility immanent in the fact that different systems may not themselves be fully related systematically. We find this type of flexibility in Lonergan's view of man as "…the being in whom the highest level of integration is, not a static system, nor some dynamic system, but a variable manifold of dynamic systems." [3] In this instance, "integration" seems more like a state with situational aspects where the systematic is found in the different parts of the manifold and the non-systematic in their coincidence. If so, we find human consciousness as a non-systematic whole open to further integrations that enable each of us to be a species unto ourselves. We do so situationally, which is the aspect of the model we will further elaborate.

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[3] Bernard Lonergan, Insight (Toronto: University of Toronto Press, 1992), p. 532.

## The Operational Situation I

Living beings are in situations where their state is part of the state of the situation and where they condition the transition of the situation from one state to another. Their significance differs depending on the situation considered. If one considers the action of one animal within a forest, its significance is minor. However, if one considers the immediate situation of the animal, its operations and actions have a greater relative significance. There is another way to consider situations. Instead of viewing the living being as simply within a situation, situations can be understood in terms of the operations of the organism. This is the operational situation. It is defined as the complex of factors which can be organized to perform an act and the context for the organism in which this occurs. The context also is constituted in terms of the organism's operations. The purpose of this discussion is to outline the model of the operational situation. It is general enough to apply to the biological and human sciences, theories of consciousness and knowing, and automation. It is specific enough to provide a framework for an integrated understanding of life and mind, and to guide research in these areas.

I will present it by first explaining what a situation in general is. As an indication of its scientific value and to build on a simpler model of situations, I will lay out the fundamentals of the physicists' notion of phase space. This is one tool for handling multiple variables in a complex situation. We will see that as phase space permits the representation of the state of a complex system, so the model of an operational situation provides the context for specifying the state of living systems. As phase space provides a means for discovering other relations by simplifying the representation of the state of a complex system, so the secondary notion of operational situations permits the finest degree of abstraction within the full situation. A key difference between the notion of phase space and the operational situation is the constituting of the operational situation by operations. Thus, a definition of operations will be provided along with their relations to functions and acts. The value of the model of operational situations in integrating the investigation of the multi-variable situations of complex systems can then be indicated, especially in the interrelations of biology, psychology and philosophy.

## Situations

What is a situation? Most generally, it is a particular place and time. In pre-Einsteinian physics this was relatively easy to consider. Time and space were considered absolute. That is, in some sense they were independent of the matter that was "in" them. The notion of being "in" space or time was appropriate since individual spaces and times could be imagined as "containers". They were constants in the sense that they were the same for all observers. However, in current theory space and time are variables related to the state of matter. Particular places and time are inseparable from the state of matter which constitutes the particular space and time. Thus, space and time is different for different observers. Two events simultaneous for one observer may not be so for another. Thus, one observers clock may not be synchronized with another's, though they may have been originally if they were once in the same place and times. Contemporary physics provides transformation equations to correlate the space and time in one situation with that in another.

For events on the scale of our daily lives, a four dimensional coordinate system can be used to represent space and time, three dimensions for space and one for time. However, in the physics of quantum mechanics, a ten dimensional system is used sometimes.

A powerful tool for representing the state of a situation on the physical level is phase space. A good popular account of phase space is found in James Gleick's Chaos.

> Any state of [a] system at a moment frozen in time [can be] represented as a point in phase space; all the information about its position or velocity was contained in the coordinates of that point. As the system changed in some way, the point would move to a new position in phase space. As the system changed continuously, the point would trace a trajectory. [4]

> Every piece of a dynamic system that can move independently is another variable, another degree of freedom. Every degree of freedom requires another dimension in phase space, to make sure that a single point contains enough information to determine the state of the system uniquely....Lorenz's stripped down system of fluid convection was three dimensional, not because the fluid moved through three dimensions, but because it took three distinct numbers to nail down the state of the fluid at any instant.[5]

Phase space is a tool for modeling situations. Phase space makes it possible to represent a multi-variable situation with fewer variables, providing the opportunity to discover patterns that

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[4] James Gleick, Chaos, (New York: Viking, 1988) p. 49-50.

would be difficult to conceive on a more detailed level. This was a powerful aid in the discovery of strange attractors. It can provide information concerning the successive states of situations by representing the states as values of variables. If elements in the state are systematically related to one another, on the physical level they can be related mathematically and their current state can be represented by a value in phase space. If they are not related, then additional significant variables can be added. The values of the variables can be graphed, representing distributions of values for successive states.

Using phase space we can model the systematic and nonsystematic elements in a situation.. Unless the situation being studied is a fully systematic system in a steady state, all situations have systematic and nonsystematic elements. Using phase space, the nonsystematic would be represented by a set of independent variables. The systematic could be represented either by a single variable whose values represent the relations of the systematic elements, or each element could be represented singly. In the latter case, the distribution would display a strong relationship between these values, which in turn would indicate a systematic relation among them..

The ground of the nonsystematic is the statistical independence of events from one another. Events are independent of one another to the extent that there are no relations between them. Individual events can have determinate causes, yet be unrelated to one another. Common examples include balls on a pool table and particles in a gas. You could trace the individual history of each ball or each gas particle, but there is no overall set of relations which account for the configuration of the moment. Instead we have a set of individual histories. Similarly, if we consider a population over time, there may be no overall set of relations which account for the

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[5] Gleick, Chaos, p. 135.

frequency of events of a particular type. If there were, we would expect the frequency to be fixed. However, in nonsystematic situations, or sets of situations, the actual frequencies diverge from the ideal statistical frequencies, and they do so nonsystematically.[6]

The lack of system can be of two kinds. It may concern the particular event, and then it is an accident. Or it may concern the set of events. In the latter case the events exhibit statistical independence.

However, from another viewpoint, a nonsystematic situation can appear systematic. This was true of the law relating the pressure and temperature of a gas to one another. With some room for errors in measurement, this appeared to be a fixed relation. However, with the introduction of statistical mechanics, this variation was traced to the nonsystematic nature of the situation. The apparent systematic relation was discovered to be a phenomenological law only. But this did not make the situation completely nonsystematic, for there are still unities and relations which form the population studied. Without them, there would be no statistics since there would be nothing to which to assign frequencies.

In summary, situations are systematic and nonsystematic. They are aggregates of spatial-temporal unities and relations.[7] Insofar as there are relations and unities they are systematic. Insofar as there are unrelated aggregates they are nonsystematic. Phase space provides a model within which to understand them which has some independence of the particular relations being studied. For example, phase space is compatible with both a classical and a kinetic theory of gases. However, it does not provide a non-mathematical treatment of situations.

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[6] Bernard Lonergan, Insight: A Study of Human Understanding, (London: Longmans, Green, 1957), p. 62.

[7] Lonergan, Insight: A Study of Human Understanding, p. 172.

## The Operational Situation II

The operational situation is understood in terms of the organism. Most generally, it is the complex of factors which can be organized to in a performance and the context for the organism in which this occurs. The context can include elements which are not part of the organism, but to which the organism is related. Thus, the context is constituted by a set of relations in the organism or has a correlative set of relata in the organism. Examples of the former are sub-situations within a biological system, or a merely psychical reality. This notion will be discussed in more detail below. An example of the latter is the processing of the visual system.

The organism is related to every aspect of the operational situation. Thus, if there is not a correlative relata in the organism for an element, that element is not part of the situation for the organism. For example, the current price of beef may influence when cattle go to market, but the activities of the commodities markets are not part of *their* operational situation.

The situation is complex. Performances are sets of acts and operations that occur within contexts which are constituted also by operations. To avoid an infinite regress or nesting of contexts, let me point out that operations form networks of relations, so that the contexts can be mutually self-constituting. In this vein, the ultimate context of any operation is the organization of the organism as a whole. The notion of the operational situation implies that, to a significant extent, the organism constitutes its own context.

Additionally, there can be multiple unrelated processes occurring simultaneously. Organisms are not fully systematic. Thus, the operational situation is both systematic and nonsystematic, as is any concrete situation. In the discussion of vision, we will see that this lack of structure provides the possibility for diversity of functions in constituting and operating within the situation.

While the operational situation is for the organism, it is not merely for the organism as conscious, but for the organism as a whole. On the level of consciousness, a situation exists for consciousness, or, in phenomenological terms, consciousness is "consciousness of...". However, conscious operations are supported by unconscious or non-intentional operations such as the workings of individual nerve cells and neural networks in memory, or the increase in the flow of blood to areas we exercise in actualizing our decisions. On a higher level we have the embodiment of our psychic development which is retained and operative though not fully conscious.

As one would expect, operational situations differ from species to species and, to a lesser degree, by individuals within a species. They also differ by degrees of development and within developmental stages. Naturally, they differ too by external circumstance, and, in higher animals, by the particular stages within the individual's motivational cycles.

The operational situation is temporal. Operations can incorporate past functioning and be anticipatory. Thus, the situation can embody a range of possibilities to which the organism is attuned. Motivational cycles are an example.

As recurrent sets of operations motivational cycles tend towards their realization in acts. The recurrence of cycles can lead to development of a complex network of flexible operations. The basic cycles are motivated by drives. These usually operate through one's lifetime or for a developmental period. Drives have biological conditions, though they usually are satisfied within the more complex organization of behavioral systems. Thus, in higher animals, the history of complexes includes psychic history as well as explanations on the biochemical level.

In persons drives can become values. Conversely, values can become motivators through linkage with feelings. The basic cycles, then, can be subsumed within a meaningful existence. We will address this in more detail in later chapters.

Though a motivational cycle achieves its apex in performance, it does not terminate in performance. The acts within a performance result in changes to the subsidiary elements supporting action. The complex of operations either assimilates them to itself, or accommodates itself to them. This changes the conditions for the next actualization of the cycle. For example long term memories may form during dreaming which can become operational in later cycles. The motivational cycle, then, can have an unconscious component which conditions its realization and which is self transforming after the acts are complete.

In higher animals, then, behavioral systems incorporating motivational cycles contribute to constituting the operational situation for an animal in the focusing of interest and acts in the performances that realize motivated goal. The acts can range from flight from enemies to hunting for food and nurturing behavior. In humans, motivations become linked to meanings and values and can be actualized in responsible action.

## Evolution and Operational Situations

The 'units' of evolution have been conceived variously as individuals, species or populations. Though any of these may be an evolutionary ‘unit’, it is also true that operational situations evolve. An environmental niche can be considered as a set of operational situations. As evolution proceeds, environmental niches are taken over by more highly developed organisms. With more operations available, the niche, and the types of operational situations that compose it, evolves. Conversely, with the destruction of habitats many evolutionary niches disappear endangering or eliminating species

There is also evolutionary pressure within the operational situation, since evolution changes not only organisms, but to what they are related. To a significant extent, it is the ability of organisms to respond to the challenges within the operational situation which drives evolution. Examples are the emergence of intentionality and intelligence.

As intentional, operations are conscious of elements correlative to the conscious operation. Consciousness is 'consciousness of'. If what we are conscious is other than consciousness, but is a content of consciousness, then conscious operations make present what they are not by organizing themselves in terms of what they are not.

We can understand how this can occur by understanding the emergence of operational memory. In general, memory is based in the recurrent performance of operations, a fundamental characteristic of life. Memory is operational when it is instrumental to performing acts. It is more general than cognitive memory since it does not embody claims about reality. It is the memory of operations performed, which is used to guide future tasks of the same type. For example, in learning to speak we remember our past sounds and those of others and use them to modify our speech. In subsequent speaking, these memories become operative. There is evidence that the development of all the senses in mammals occurs by the formation of operational memories. In turn, these are correlated to neural development. This also occurs in skills.

Living systems act within nonsystematic operational situations. This means that external occurrences are realized in accord with probabilities. The recurrences can be more or less similar. In dealing with recurrent events it is an effective strategy to retain successful past functioning. As noted, this is the foundation for memory. However, since it is to be operative, memory also is anticipatory. It is an organization of the organism in terms of what it is not, the recurrent external events in the operational situation. It embodies the general structure found in intentional operations.

With a memory-anticipation structure, innovative activity must emerge to make adjustments in the present situation between the operational situation as anticipated and as actual. This provides evolutionary pressure for the emergence of intelligence. This adjustment may be the emergence of different capacities, but ultimately, what ever capacities there are, they need to be tuned to the situation. This is done by combining them in different ways, timing action and so on.

Cognitive systems exploited this evolutionary gradient in moving from the extroversion of the object in sensitivity, to knowledge of the unimaginable via the organization of symbols which refer to what they are not. If we accept that we know what actually is, then there has been a correlative evolution of intelligence from regulating systems which operate 'analogically' in terms of the body, to knowledge of real things and events, or knowledge by identity, with a corresponding self transcendence. Symbolic processing is the perfect mediator for such transcendence since it enables reference without begging the question of intelligibility, or constituting the intelligibility of the known.

The notion of 'analogical' processing helps us to understand operations mediated by the body. For example, in building a nest certain movements of the bird are related to different placements of materials within the nest. By organizing the movements, the nest becomes organized in a particular way. By changing the possibilities for organizing the movements, different kinds of nests become possible. Thus, internal regulations can yield external regularities. In operational memory the converse can occur. External events can yield internal transformations which become analogous to the external events. In addition, the whole process can be internalized, as in the avoidance of anxiety arising in conjunction with a particular memory.

Returning to intelligence, since there are multiple elements, it is most effective if there is a central operator which has access to them. With more than one central operator, the organism could be immobilized through conflict concerning which actions to choose. As it is, we have internal conflicts between "subsystems" or operational centers, but they usually can be resolved or overridden to permit immediate action. This central operator has emerged as the irreducible (for us), free, attentive core of consciousness.

Minds vary, then, depending on the operations they have available and the operations they perform. The state of a mind, as well as the state of the operational situation, would be the particular configuration of its operations and their relata. Since that configuration is both anticipatory and nonsystematic it needs to be understood in terms of probabilities for action as well as in terms of its present acts.

These are instances of the general pressure within the operational situation for the emergence of ever more complex and refined anticipatory operations. In turn these require greater complementary compensatory skills to adjust to the actual situation. As this situation becomes iterative pressure emerges for ever more complex and varied operations. One can get a sense, then, of how evolution can be "self-driving" in the emergence of greater complexity if the locus of evolutionary pressure is in operational situations.

## A Secondary Notion

Much of development and existence within developmental stages is the performance of operations on operations. As the example of the emergence of intentionality indicates, for one set of operations, the set of operations it regulates are part of its operational situation in a manner similar to that of external things and events. The internal environment can be part of the operational situation, not simply as operator, but as operand. This situation is iterative on each “level of complexity”. Many biological regulatory functions work this way. Operators in the cell regulate internal functions as well as relations to external elements. The immune system regulates itself to some extent as well as operating on other elements.

This indicates that there is a secondary notion of the operational situation. If we consider operations only and not acts, then we can consider the internal situation only. We also could consider operations in their relations to the external aspect of the situation. An example would be the tearing of the eye on a windy day. Though it can be considered in itself, its real significance is found in the full situation. This could affect the vision of a tennis player, for example, causing him to mis-hit the ball. Or it could clear dust from the eye of a contact lens wearer lessening their irritation and permitting them to see better.

A more complex example is the structure of the eye itself. The rods and cones of the retina fire differently for different occurrences. Some, for example, fire only for vertical movement, while others fire for lateral. The rods and cones provide a mosaic of operators which can be related to an indeterminable number of visual fields. The same is true of the possible motions of the digits on the hand. For example, the movement of one finger traces a curve, which, mathematically, has an infinity of points; likewise with the other digits. Conceivably, then, there is an infinity of possible combinations of positions. In actuality, however, the combinations are bounded operationally. We do not try all possible combinations, nor do we have a propensity to do so. In general, we combine movements in terms of acts we perform, where the movements, as operations, contribute to the act.

In short, the visual field is constituted by a population of neurons. The population will handle whatever is there within the range of their capacity. As a population, it is an aggregate. Its lack of organization is what makes the visual field possible. The openness of the system allows it to handle a range of visual experience. It also allows it to be in relation to the non-systematic situation. As we all know, the visual system in the eye is supplemented by other processing, memories, anticipations and so on. But there is a statistical residue here also. This permits more complex organizations of operations to have a similar flexibility in handling the nonsystematic. Now, one may disagree with this simple analysis of the visual system. The point, however, is not to discuss what vision is, but to understand the secondary notion of the operational situation. We have illustrated that notion by discussing the operations of the retina and their general relations to nonsystematic external events and to the higher integration of their outputs by the higher visual and psychological centers.

## Theories, Models and the Secondary Notion

A theory is a set of explanations. An explanation is a set of terms and relations which answer "Why?" "What?" and "How?" questions. To understand why something happened is to understand what happened or how it happened. If we focus on the key set of general terms and relations we can create a model. Models include key sets of expressions, images and symbols which correspond to the key relations. As a set of general terms, relations and examples, models can be varied as required to grasp particular instances.

What is a complete explanation? As we discussed earlier, a complete explanation of an organization would tell what it is and why it is what it is. The latter would include the part of its history pertinent to its becoming what it is and an account of the present relations which maintain its current state. The account of its history would recede to the point where the conditions for its emergence became present. For example, life emerged because the conditions X, Y and Z were present. To ask why the conditions were present is to ask for an explanation of them. Though it does have a bearing on the explanation of life, its bearing is subsidiary to the bearing it has on the explanation of the conditions themselves. The fact that we need to ask another question about another set of organizations is indicative of this.

If an organization is organized within a larger context or a greater whole, the explanation would include an account of those parts of the larger context which influence its structure.

It may seem that we need to explain the whole organism to explain part of it. There is some truth to this, since the organism is a unity. But since it also is not fully systematic, the unity is partially de facto. The notion of animals having a "republic of instincts" and the corresponding inability to outline an integrated theory of one motivation underlying all of a person's acts are indicative of this.

The model of the operational situation overcomes this problem by distinguishing the primary and secondary notions. The primary notion would include all operations and their correlates which have a bearing on an organism's acts at a particular place and time. The secondary focuses on some subset of operations and their correspondingly reduced context and range.

## The Heuristic Value of the Model

The operational situation is caused partially by operations and partially by “external” events. However, the range of external circumstances which are relevant is determined by the capability of the operations to relate to them. Operations, then, play the primary role in constituting the situation. For example, just as physical space and time are determined within particular states of matter, so organic and psychological space and time are constituted by operations with some reference to physical space and time.

When operations regulate other operations, the primacy of operations is unambiguous. When operations transform "external" circumstances, transforming the situation, their influence can be matched by "external" transformations to which the organism must adapt. However, as noted above, the range of events which are significant is determined by the operational range of the organism.

The key to defining the operational situation, then, is to define the operations. In science this takes two general directions. The first is to focus on operations within a complex unity, such as understanding the operations of white blood cells in fighting infections by gathering data in vivo. The second is to create the experimental situation to isolate operations by simplifying the "external" circumstances.

In either case, the results need to be integrated within the understanding of the broader situation to overcome possible deficiencies caused by abstracting. This is clearest in the second case. Discovering the operations a rat uses to navigate a maze does not give the full range of these operations within the animal's lifecycle. To do so would require observing their use in the "natural" habitat.

One heuristic precept then, is to discover operations. A second is to acknowledge the nonsystematic. To do so is to recognize that not all operations are related, nor are all the external circumstances. They need to be understood statistically.

A third is to acknowledge the relations between organizational contexts. Both greater and lesser complexity within an organization are explained to some extent in terms of each other. That is, the organizer and the organized can be explained in terms of each other. The notion of operations within all contexts permits a multi-contextual explanation within a single model. For example, it is possible for emotional expression to be unconscious, conscious but not at the focus of attention, and integrated self-knowingly into our acts. Each, with respect to the emotional operators, is a different situation. But it is possible for all three to be operating at the same time with respect to different emotions at different stages of expression, constituting our emotional state. We could explain the levels of expression within the state from the level of the operations of neural transmitters through the expression in acts.

The same is true of knowing. If philosophy considers a higher level of generality than other fields, and if the generality is of operations, then it would have a biological component in the neural support for knowing, a psychological component in the cognitive operations, and a philosophical component in the focus of those operations on philosophical issues. The emergence of a philosophical model, then, would be a transformation of our state of mind with operational implications radiating throughout the levels of organization, with the simultaneous transforming of our psychology in its basic orientations and the neural substrate supporting it. The understanding of the model of operational situations, transforms our own situation and provides a context for understanding the transformation.

The model has metaphysical implications if we consider the set of relations of cognitive operations to reality. Kantian, phenomenological or critical realist positions, though theoretically irreconcilable, can be conceived within a single view to the extent that they are models of the cognitive operational situation, outlining which elements are relevant and which are not, where the relevance is conditioned by the cognitive operations.

It has implications also for theories of sports or skills where the relevant "external" factors are selected in terms of the acts to be achieved. What is "external" for a highly proficient player is different from the average player. The space of a tennis court is higher, wider and longer for a professional tennis player since they can play more of the "outer" court. Time differs also since events occur at different speeds than for the average player. In addition, different situations are created due to the skills of the players, situations at which the average player can only marvel and exclaim "How can they do that?".

The example of the tennis players is one of mutually conditioning operational situations. These occur in behavioral systems such as those conditioning attachment behavior in mother and child. The fact that operational situations evolve is seen in the evolution of behavioral systems[8] and the corresponding evolution of culture in animals.[9]

## Conclusion

The ability to specify operations, their range, and their current relations within a situation circumscribed by them presupposes a model for understanding life analogous to the physicists' use of phase space. We saw that the model of an operational situation provides the context for specifying the state of living systems just as phase space permits the representation of the state of a complex system. Phase space also provides a means for discovering other relations by simplifying the representation of the state of a complex system. The secondary notion of operational situations provides an analogous simplification by permitting the finest degree of abstraction within the full situation. It also provides the context for integrating the results within the larger, real situation.

It should prove especially fruitful in integrating biology, psychology and intentionality analysis in providing a model of mind. The integration of biology and psychology is a scientific task. Insofar as it has a bearing on resolving philosophical questions, intentionality analysis is a philosophical task. Otherwise it is psychology. The integration of the two is a scientific and a

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[8] John Bowlby, Attachment (New York: Basic Books, 1969) pp. 74-84. Provides excellent account of behavioral systems.

[9] John T. Bonner, The Evolution of Culture in Animals (Princeton, N.J.: Princeton University Press, 1989). Provides numerous examples of the evolution of behavioral systems.

philosophical task. The model of the operational situation provides a common terminology and a conceptual framework where different parts of complex processes or integrations can have different qualities or different manifestations. We saw the latter in the expression of feelings. The former may be the case with the mind where different neural networks perform different functions and where a threshold level of a type of neural activity is probably a condition for alertness. Finally, it provides a model for different disciplines investigating a common, complex living being. For example, neurology, psychology and philosophy all regard conscious acts, but they do so within different contexts. These contexts are understood through the secondary notion of the operational situation. Their seamless integration and their dysfunction are understood in terms of the full situation. It is the role of the philosopher to indicate the outlines of the integrations of scientific and philosophical results. To indicate the heuristic fruitfulness and explanatory power of the model we will elaborate a notion of neural and conscious functioning in terms of the secondary notion of the operational situation. We then will integrate both with the full notion of the operational situation by understanding the explanatory primacy of performance in understanding ourselves and other animals. By doing so, we also will address issues in the philosophy of mind relating to the understanding of biology, consciousness and behavior.