THE SECOND ORDER OBSERVER AND ARISTOTLE'S *MESOTES*

A contemporary interpretation of Aristotle's *mesotes*

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ABSTRACT. *Mesotes, the measure of the center is a major element in the definition of human virtues in Aristotle's Nicomachean Ethics. On the one hand the principle of mesotes often is described as powerful. On the other hand the implementation of this principle to certain problems seems to state non satisfying solutions. This might be an outcome of observation dependent distinctions these possible solutions are based on. To find an adequate description of mesotes, it could be necessary to deal with the observation process. This implies the observation of the observation itself and the distinctions of relations, structures and systems getting effective in the specific observed process.*

Relations, structures and networks in systems science on the one hand are analyzed using mathematical tools based on rational thinking. On the other hand these complex systems are origin of emergent and those way new phenomena that cannot be expected by the ongoing analysis. Heinz v. Foerster claimed a second order observer to deal with those circumstances. This paper mainly deals with implications of the principle of the second order observer and formulates thoughts that can be interpreted as a contemporary view of Aristotle's mesotes.

This second order observer is able to notice the togetherness of the "subject – object" relation and to deal with the implementation of as well . . . as – rather as to ask the question, whether to prefer one or the other point of view.

KEYWORDS: *self-reference, systems science, Aristotle's mesotes, second-order cybernetics, togetherness of the "subject – object" relation*

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1. Aristotle's *Mesotes* I

Mesotes names the messure of the center. Questioning the determination of the center is on the one hand considered to be calculated mathematically and seen as numerically defined balance between excess and deficiency on the example of 10 and 2 equals 6. As a result, Aristotle notes, however, that these mathematically representable centers may not apply to every human being and therefore cannot be applied for individuals. What might be the right amount for the middle for one or another could be too much or too little. [Aristoteles, 1975, II 1106a29-1106b5] These representations have led to ambiguous interpretations, because the mathematical definition of the good was perceived accordingly as inadmissible and not a qualitative necessary distinction. Therefore, *mesotes* is called an indeed powerful, but *dark and empty* concept. [Höffe, 2006, p. 225]

While dealing with the measure of the center between excess and deficiency, one could determine this center as some kind of mediocrity. Nobody would assume Aristotle to define mediocrity to find the way to eudaimonia – living a good life. Aristotle's beliefs seem to claim a detailed discussion, because a general presentation would not be able to meet the key aspects. So he refers to a lot of differentiations in describing and analyzing single examples to explain the idea of *mesotes*.[Schilling, 1930, p. 3] This amount of descriptions concerning virtue as mid points confirms the assumption, that this principle applies everywhere.[Aristoteles, 1975, IV 1127a15] *Aretê* for all being is essence of realization and completion. [Schilling, 1930, p. 7]

This point of view confirms, that *mesotes* on the one hand is the middle of opposite positions, on the other hand it is some kind of optimum output to find *mesotes*. To define the appropriate measure for a particular case you need to analyze this single situation using a certain principle. Both the principle and the measure may be called *mesotes*.

For all these considerations concerning the definition of the center of whatever, we need an observer – the subject performing the observation – and an object – a thing or a process being observed. Observing in the first step needs to define the object and to draw a distinction between this object and the circumstances – in other words to define something as a whole. The next steps allow observing this whole and its parts, the relations of the parts and the relations of the whole and the necessary environment. The inevitable needs for this kind of observation process demand the definition of various differences and relations i.e. subject and object, the whole and the parts, system and environment, observer and observed.

2. The Whole and its Parts

In his Metaphysics Aristotle already pointed out that the whole could not be derived from its parts. [Aristoteles, 1904, VII 1041b] The sum of the parts that constitute a whole either is more or less than this specific whole. Usually it is interpreted as more. The possible contradictory interpretation we owe Niklas Luhmann [Greve, 2011], asking, why the whole usually is interpreted as more than the sum of the parts – under certain circumstances it might be interpreted as less.

With this statement Luhmann refers to the need of an observer without explicitly expressing it. As a consequence it can be assumed that the whole and the sum of the parts are different.

The naming of two parts hydrogen and one part oxygen as water may be used as an example. Not to prove the reductionist dimension of scientific observation of natural phenomena but to point out, that a discussion of the difference between the whole and the sum of its elements on the one hand has to use an abstract description of the parts and the relations of these parts, on the other hand describes the appearance of the resulting whole. This discussion needs some reflections considering the living environment to be able to easily follow the abstractions.

These first assumptions already make clear that there obviously is the need for an observer to be able to evaluate the whole or the parts, to define more or less of something, to describe circumstances and facts, to determine systems and environments. This observer states a common object – subject relation within academic activities with his observation. To describe this process of interconnections between objects, the parts of this object and an observer as the subject within this whole observation system, we need a *second order observer* [von Foerster, 2003, p. 244]. This second order observer needs a step to a higher organization level within the observing activity. This principle of this *second order observer* – the observation of the observation – Aristotle already anticipated with the *thinking of thinking*.[Aristoteles, 1975, IX 1170 a28]

The description of a second order observing process and the thereby generated transformations of relations between subject and object make it obvious, why everyday life more and more can be seen as a complex matter. Relations in society, politics and economy cannot be specified by simple statements. Everyday life is getting more complex instead. The term *complexity* is omnipresent in the sciences of mathematics, physics, biology, informatics, medicine, sociology, economy and management and so on. What characteristics describe thisterm complexity? The properties of a whole or the parts? Niklas Luhmann identifies the concept of complexity with an autological and self-referential operation. Complexity seems to be a description of properties that show unmanageable relations and dependencies of elements within the observation process of the specific system. The observations therefore need ongoing distinctions – this way the observations themselves are examples of autological and complex processes.[Luhmann 1984, pp. 46]

Connected to the property of complexity are notions of structure, network, system and the declaration of a process called emergence. Descriptions of observations are becoming abstract terms, subject areas and systems – that show common grounds of dependencies – using the organizational power of language. The relations of elements within these systems are described by the necessary observer using structures and networks as order parameters. The use of order parameters depends on predefined rules. These predefined rules are the outcome of historical observations. The intention of this abstraction is the ability to construct basic explanatory models to be able to predict future incidents.

Compared to the dominant position of the mechanistic view of the world, this view is not deterministic in detail any more. Enormously advanced mathematical and technical capabilities support the construction of new and enhanced explanatory models based on probability.

Man observes and makes distinctions continuously. Within science, these distinctions follow the rules of each field of knowledge in which research is done. In the natural sciences, these rules are based on mathematics and physics, in the humanities on logically coherent thinking concepts. In relation to the living environment, the rules are based on cultural norms. Both, the rules of science and culture are time and location dependent. In the face of change in global communications and the world of media, development of new explanations based on complex facts is required. Such explanatory models provide the theories of complex systems in dealing with non-linear dynamics, complexity, emergence and complex-adaptive systems.

Explanatory models and the position of mankind in this world are the goal of science since antique times. Basis for all knowledge is the ability of man to express his perceptions and observations with positive explanatory models and statements using consistent thinking. Prerequisite for this kind of logic is a distinction that is based on divalent statements, that means, a statement can either be true or false. Based on this idea of linear processes modern science since Descartes developed. This mechanistic worldview of scientific reductionism is accompanied by its explanatory models, very successful in describing the world. Axioms of mathematics are indispensable tools for these models. The possibility to display reduction with formulas and the claim of possible science-based prediction – associated with this formalization – became one unquestioned, deeply rooted principle. [Juarrero and Rubino, 2010, p. 4] This went to the extent that even natural laws have been interpreted as mathematical laws. In the early 19th century mathematics itself provided evidence that theorems interpreted as axioms by then, could by questioned. For example, the confrontation with the Euclidean geometry for the mathematician Carl Friedrich Gauss did not mean an examination of the field of truth, but an issue of mechanics. In his research he dealt, among others, with non-Euclidean geometry theories – even though this kind of theories has been rejected as strange by the majority of colleagues at that time. That may have been the reason that he did not publicize his thoughts. [Kline, 1982, pp. 67] An indication that science systems not only follow the rules of science, but also are subject of social and cultural fundamentals and thus underlie diverse and complex relationships. Interesting concerning the observer's position is a remark made by Gauss in a letter to Friedrich Wilhelm Bessel of 11 November 1811: *„Man sollte überhaupt nie vergessen, dass die Functionen, wie alle mathematischen Begriffszusammensetzungen, nur unsere eigenen Geschöpfe sind ...“ One should never ever forget that functions, like all mathematical concepts, are only our own creatures ....* [Gauss and Bessell, 1880]

Physics as the basic science at the latest since the Copenhagen interpretation of quantum mechanics from 1927 is confronted with the fact that at the level of the microcosm the observer affects the measurement result and so the hitherto assumed linearity of causality and thus the predictability and calculating of cause and effect is no longer given. In the macro world, this function of the observer is supported by the theory of constructivism. This problem of the role of observation or measuring in the case of quantum mechanics and the possible need for some kind of a priori to human knowledge in general states a main aspect of dealing with the realization and description of complex relationships and interdependencies. These mentioned circumstances necessarily demand the questioning of the relationship between observer position and reductionism.

Heinz v. Foerster's statement, that he became a metaphysician doing physics [von Foerster, 1985, p. 84-85] (and) [Dammbeck, 2003, 1:10:57f], describes a movement from reductionism, from looking at the smallest parts to a view of the whole (thing). Scientific knowledge requires a movement from the whole to the parts and the relations of these parts to each other. A dichotomous view of the world raises the question of the right approach. Dealing with systems and complexity is an attempt to use reductionist thinking to gain a view of something whole.

3. The need for an Observer and the Second Order Observer

For a long time the necessary observer to describe an observation was seen as a possible subject outside the observed or even observable world. This strengthened the believe in the ability to make absolutely objective considerations. This went so far that one might have thought that a description of the world without any observer could be possible. However, without observers there cannot arise any description of the world. [Pörksen, 2002, S21f]

As already mentioned – the Copenhagen interpretation of quantum mechanics questioned that up to this time axiomatically assumed absolute objectivity with the detection, that the measurement of an observable photon influences the measuring result significantly. The perspective of the second order observer – the observer of the observer – is not able to support such a subject-object separation anyway. This second order observer realizes the inseparability of the observer and the observed objects. This Meta point of view can be taken for every observation process – this provokes the origination (emergence) of a structured landscape of observers / observations. Every observer initiates a social interaction with the description of his observation – he needs an audience listening to the description of the specific observation – the listener simultaneously is an observer and belongs to at least one – in most cases several observation systems the primary observer belongs to. This kind of social activity, the used symbols to communicate the observation and the stability based on ongoing recursions in speech and thinking strengthen the status of the original observer and his description of the world. [Pörksen, 2002, S36]

Defining the primary and the listening observers as systems in a certain relation, they simultaneously are elements within the same system. The definition of system and environment depends on the distinction made by the primary observer, who reduces his ongoing observation and concentrates on the system. Each specific definition of a system therefore is an explicit reduction. Approved scientific methods allow exploration of subject areas by ontological reduction. On the one hand this proves that there are several / many / countless subject areas, on the other hand each topic needs different methods of description. This leads to different descriptions, formalisms, rules and even different language terms within different subject areas.

Distinctions might be described as absolute or relative. An absolute distinction – that means a system (object) differs from others only by being different – would include no information at all, would have no explanatory power and would therefore be useless. A relative distinction implies the differentiation of several systems (objects). This kind of statements and information requires further distinctions and differentiations [Gabriel, 2013, S83f] and constitutes the attempt to describe multiple relational circumstances. Nowadays we call this situation complexity. The required necessity and diversity of elements, systems, observers and thus possible worlds and environments, with complex dependencies shapes both, the scientifically explorable universe and the obviously necessary – but not explorable – environment of the universe. Questioning the world therefore always is questioning the point of view of an observer, which is incumbent on the second order observer. The size of the defined and thus observed world makes no difference in principle. The description of different worlds through the respective observers using different languages and the difficulty to compare these descriptions with each other, states Wittgenstein with *"The limits of my language, mean the limits of my world".* [Wittgenstein, 2006, 5.6]

The identification of terms used in contemporary scientific research like complexity, networks, structures and the phenomenon of emergence mandatory needs two observers for observations and the following social interaction and a second order observer, who can describe this social interaction. The observer is capable to observe only patterns as regularities – stable states for a certain amount of time – that meet his own structure and his expectations. The perception of stable states in this process is bound to former experience of stability. Experiments in natural sciences use the observing of a measurement process as fundamental observation – this fundamental observation of a measurement process allows identifying an unstable, insecure state as a stable state for the observer. The second order observer is able to define the discovered stability as a quantitative determination, which does not allow any qualitative conclusions about the underlying process.

4. Draw a Distinction – the Principle

Necessary to carry out an observation is an initial determination – a distinction that separates first and foremost the system to be described from the environment. As the result, elements and characteristics of the system are analyzed in detail. Further distinctions that have to be seen in relation to the first distinction and as self-referential operations related to the observation system make it possible that the system will be worked out in detail. The observation of these observations and the descriptions of these observations are incumbent on the second order observer.

An initial distinction has to be interpreted as logical calculus and thus makes use of an argument known from natural science. This distinction separates the system to be observed from the environment. The ability to draw such a distinction already requires rules and criteria, which represent fundamental assumptions on which this first distinction is based. This means, that the observer who describes this system, needs something like a structural embedding into an existing system, to be able to formulate a statement concerning this specific system. Such structural conditions represent some kind of determination. At the same time the observer states an act of freedom drawing a distinction within this determination. Operating this distinction causes the definition of a phase transition and determines the dichotomist view with the construction of system and environment (inside vs. outside).

This distinction process in addition needs the observer's decision to want to distinct and his ability to distinct. From the point of view of system theory this states dependencies in vertical and in horizontal directions. The distinction of the organizational level is caused vertically – distinguishing the components of the finally selected organization level can be seen horizontally. This means that the observer himself is already a result of distinctions. The act of distinction on the one hand has to be done and can also be selected by the acting observer [Luhmann, 1990, pp. 12]. Accordingly a distinction is composed of a determined and an aspect interpretable as freedom, once the decision was made to make a distinction. It can be deduced that any development or differentiation can be seen within an overall context of distinctive actions. Every observation requires a preceding and a subsequent observation (or confirmation) and therefore is part of a time-related und self-referential process embedded in social interactions controlled by the path-dependence within the space of probability.The description of these phenomena is function of the second order observer – this second order observer absolutely can be the original primary observer or actually another observer. The repeatedly asked question of possible conditions of observation shows that a theory of the observer must be applied to itself and thus necessarily proves to be a self-referential process.

Each question of a beginning or an end can relate only to the question of the beginning and end of a concrete observation. In addition questioning the beginning or the end the need for further distinctions can be seen. So the original intention of distinction, the reduction of complexity, causes increased complexity again. Both, the question of the beginning and an end each demanded a necessary distinction between before / after and this way correspond to a potentiation: distinction^{distinction}. Linked to the question to before / after are the questions how these distinctions were made and finally who has drawn these distinctions [Luhmann, 1990]. Obviously it is not possible to draw a distinction without an additional question concerning the previous distinction. The limitation of the probability space – according to Luhmann, the definition of a system and thereby the reduction of complexity – generates new opportunities and thus an expansion of the given possibilities including new adaptation processes with every distinction following the respective previous distinction.

Systems Theory, based in the General Systems Theory of Ludwig von Bertalanffy has to be expanded with the analysis of complex systems and thus with two essential aspects. The originally developed system concept was treated as a generally accepted definition, the defined structures have been seen both as static, on the other hand as objectively determinable. The study of self-organization and evolution directed attention to the process of the systems formation, circumstances in which they emerge and how the adaptation process can be explained. [Heylighen, 2007] Simultaneously with the definition of a system necessarily the position of the observer has to be stated and the possible statement of objectivity is to criticize. Individual cognition ability and subjective cognition becomes an environmental element of the system to be examined and the object to be examined turns out as a relevant part of the interaction between the system and the environment. This again leads to the term *second order observer*.

The – this way centered – observer, in scientific research the measuring methods and instruments, a single scientist or a research project, in the living environment each person, each family or other social groups, simultaneously can be seen as a system within an environment and as an element of one or more systems. The research of this way interacting contexts calls for a combination of aspects of theories of cognitive science, evolutionary self-organization and the theories plus the related simulation of complex adaptive systems.

5. Complicated or Complex

The findings of Isaac Newton and the subsequent adoption of laws by which all physical phenomena by virtue of their causes are predetermined, marked the scientific picture of the world since the 17^{th} -century.

Synonym for this deterministic worldview is the demon of Pierre-Simon Laplace. The idea being aware of all initial conditions and all laws of nature, empowers an observer like the demon to calculate all future, present and past states of the world, and requires a consistent cause – effect model. The cause of unrecognized physical conditions would therefore be based on the ignorance of conditions or laws. Up to the beginning of the 20^{th}-century, physics exclusively dealt with such linear and therefore predictable phenomena.

Quantum mechanics and especially the 1927 Copenhagen interpretation have shown, that, at least at the micro level, linearity can’t be maintained because of the influence the processes of measurements have on the results.

The idea of the world as trivial machine was no longer the only one possible. The therefore necessary object – subject separation could no longer be argued. Heinz v. Foerster describes this in detail. [von Foerster, 1993] If the worldview of the Laplacian demon would be plausible, the world should be a trivial machine. However, this could only be the case if the observer would not be considered as a part of this world. A necessarily strict separation between subject and object is the result. In this case, the world would be a very complicated thing. We could take this thing apart and reassemble it again, without any loss. The system therefore would not differ from the sum of its parts. However, we are not able to assume, that all processes in the world follow the principle of trivial machines. Heisenberg's uncertainty principle, for example, shows that not only the observed appears to depend on the observer's point of view. It also has to be accepted, that the observer and the current relation to the object in theprocess of a specific observation is of importance.[von Foerster, 1993, p. 252] The fact, that the human observer can't be aware of any possibility to get rid of the observer's role – otherwise there would nobody exist to state the observation – may state the evidence, that an exclusive interpretation of phenomena in terms of cause and effect could not fully explain what we call *World*. A statement showing this, among other things, provides Heinz von Foerster's indication that a system with a single non-trivial element automatically turns into a non- trivial machine [von Foerster, 1997, p. 52] and therefore cannot be calculated in advance.

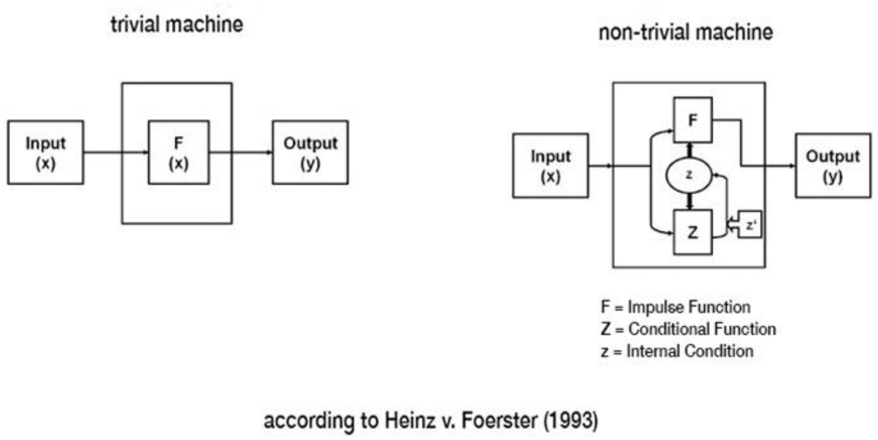

Figure 1: trivial and non-trivial machine according to Heinz v. Foerster

A trivial machine makes the result of outputs (Y) determinable on the basis of function f(x), is independent from the past and therefore predictable. The non-trivial machine depends on the internal state Z, can't be predicted, therefore is not determinable and path dependent.[von Foerster, 1993, p. 360]

Unlike the term complicated, complex is the description of a condition that shows: along with the reduction of a system to the individual elements, the system itself does not longer exist. Furthermore reduction depends on an observer's view and this is pointing out, that complexity is not a property of the world, but a statement of the observer, who is not able to detect the phenomena in the world in detail. Under this assumption the term complicated encounters by people physically designed systems. Systems, which are based on predictable cause-and-effect relation and most of the time, do what they are planned for. A trivial machine provides known output for a certain input.

Each type of life, however, is to be regarded as complex. For a non-trivial machine this means, that for a given input, the predictability of the output is not given. The internal status of the machine is engaged in the processing of the inputs in a manner that makes prediction impossible. The term complicated represents a *factum*, a generally manmade, composite thing or system. This thing or system may appear very complicated to observers, on defectiveness or removal of a part it not necessarily loses its functionality and with the replacement of this part it can be restored.

A complex system (phenomenon) on the other hand will stop to be this particular system by elimination of an element. This also yields the proposition, that the whole is more than the sum of its parts. Such complex relationships can show simultaneous spatial effects and include temporal aspects too. So certain expectations – the future fulfillment – have impact on the presence, while these present influences affect the future again.

These kinds of phenomena are observed daily – i.e. in our economic driven world described with the term market. Markets are interpreted as complex systems. They are not predictable, but are shaped by expectations. These expectations lead the participants to get involved or to withdraw. The different market players have divergent interests, based on a variety of interdependencies. This leads to unpredictability of the market while self-regulation occurs at the same time.

Today the term complexity often is used as an aspect of some kind of confusion – confusion in the sense of chaos and sometimes associated with complicated connections. The explanation of complexity as a description of a process brings in some light and may explain the definition in the first step to apply the differences between complex and complicated. Attention is explicitly driven to observable processes of a non-trivial system in coincidence with the certainty, the observer himself being a non-trivial system.

The construction of a machine with various specific components is a quite complicated matter. The operating of this machine requires planned interaction of the individual parts to fulfill the scheduled task – this is the challenge for designers. The interaction of this complicated machine with the environment may be described as a complex situation. Thus, a complicated machine like a car on the road particularly depends on the environmental conditions: the constitution of the driver, the nature of the road, traffic growth of all vehicles involved, the weather, the time of the day and in the end on the status of the particular components. Increasing traffic causes increasing uniform movements of the individual vehicles. Too much traffic in relation to the available space on the road leads to traffic jams, to gradual progressions in shock waves. [Haken, 1999, p. 41]

Feedback loops and their effects are significant for complex systems and constitute the formation of structures and networks. This observable structures and patterns show a possible principle of order for an observer. Observed changes in the structural drift between system and environment are subsumed under the concept of self-organization.

6. Feedback and Recursion

As just mentioned, linearity describes a proportional relation between input and output in a system – this causes known output values with the knowledge of the input value and the structure of the system (i.e. applicable rules within the system): the description of a trivial machine.

It is an undisputed fact that trivial machines exist – but also it is undeniable that not every system can be a trivial machine. Man incessantly is faced with linearity, nonlinearity, feedback and recursion. Cybernetic principles are capable to explain processes observed, without wanting to determine the results of these operations in advance. Processes of feedback loops, in which the output takes effect on the input, can be observed. This feedback in nonlinear processes on the one hand causes attenuation of a generated development (negative feedbacks), on the other hand the strengthening of the process itself (positive feedbacks). A classic example of the use of feedback in mechanics is a so-called centrifugal governor. With the rotation speed of the controller a throttle valve is closed by the increased centrifugal force. The rotation speed thereby is reduced – this leads to the state of an equilibrium that can be seen as relatively stable.

An observer of the process of growth notices positive (reinforcing) feedback loops – regardless whether the growth itself is rated positive or negative. Within the economy system i.e. revenue increases and the increase of debts are associated with these feedback processes. In political and social environments i.e. the introduction of taxes are measures used for the attenuation of inequalities in society and can be described as instruments using negative feedback.

Successful applications are repeated. Despite high implausibility of stabilization, an observer is able to notice such a thing like stable states. These stable states themselves are dependent on the system itself and the type of structural determination within the system. Heinz von Foerster described this property of a system as *Eigenvalue* or *Eigenbehavior* – as an example he referred to the function of root extraction. Regardless of the starting value – whether 1000 or 0.2 – after a number of operations processing the same rules (= structure of the system) always the same result is shown (in the case of the square root Input> Input root> root. , , , = 1.[von Foerster, 1993, p. 103]

A closed system seeking a solution in this recursive and self-referential manner accepts its own output as input to the next operation and not, as one might expect, any interference based in the environment. Some environmental disturbances may occur under certain circumstances, triggered by structural coupling. The input and the type of operation come from the system itself. The above presentation of the mathematical root extraction here is used as a simple representation for everyday processes in the living world. This *eigenvalue* is inherent to biological and social operations. Illustration of such biological and social interactions is reproduced much harder than a simple mathematical function. Furthermore it is fact that both, biological and sociological systems not only are subject to a single *eigenbehavior*, but representing a relation of various structural *eigenvalues*. So both, the system and any observation initialized by the system, deal with complex decisions.

Feedback and ongoing recursion play an extremely important role in any learning process. The perpetual repetition of vocabulary, when learning a foreign language, may be used as an example. The ability to gain experience and the associated internalized know-how using positive or negative feedback on the one hand increases the opportunity to deal with perturbations based in coupling with the environment, on the other hand, this reinforces the intrinsic behaviour of each creature.

Research of ant and bee colonies, especially the foraging process, has indicated that the behaviour of the species can be interpreted by observers assome kind of social learning. Better abilities to find food increases the probability of population growth, leading to more individuals who engage in foraging and so again increases growth probability, an example for a positive feedback-loop. [Füllsack, 2011, p. 250] Desired learning effects are amplified = rewarded otherwise adverse effects are weakened = punished. We then talk about *Reinforcement Learning* [Füllsack, 2011, p. 253] – concerning animals this is called dressage – concerning humans we refer to the term education.

Aside from the need of feedback for biological existence and the human cognition and learning ability, feedbacks are used in many applications in daily life. Electronics- and computer- technology, climate research and weather forecasting, as well as psychology, social- and communication theories nowadays are inconceivable without feedbacks and the associated effects.

7. Reductionist Approach and the Second Order Observer

The fact that knowledge in general and scientific knowledge in particular require a reductionist approach to be generated, demands an observer, who differentiates between the observed system and the environment not observed. This reduction to a defined – limited in the truest sense of the word – observation field, always disregards a part of the original problem to be solved. Discussions following the concept of emergence prove this, because emergent phenomena cause that no part of an emergent whole may have the same characteristics as the whole itself. The investigation of parts will never be able to make valid statements about the original whole system or problem, that should be examined (Remember Aristotle in the beginning about the whole and the parts).

In this context Karl Popper argues, that in the reductionist approach always remain some remnants. Therefore science is able to create hypotheses and theories and generate knowledge with investigation, this knowledge however always will remain conjectural knowledge. [Popper, 2012, pp. 115] From the point of view of the second order observer, reductionist answers dealing with problems lead to further questions based on observing the relations of the involved organizational levels. That does not mean, that reductionist answers to generate knowledge has gone obsolete, but should point out, that every solution of a problem generates new problems – all answers demand new questions. Knowledge generated by reductionist methods itself is subject to complex processes. This process and the implied questions and solutions generate new hypotheses and theories. These hypotheses and theories represent the emergent phenomena of the ongoing process of knowledge generation.

Man searches secure truths and thus for true security. The differentiation between *Truth of Reason* and *Truth of Fact* Leibniz expressed [Leibniz, 1962, p. 73], can be located in the viewpoints of observer and second order observer. The observer who seeks to prove theories and hypotheses within the respective monitoring system in case of success will rely on *Truth of Reason*. The necessarily occurring the question of either – or corresponds to the logical premise of the Law of Excluded Middle *(terbium non datur)* and allows only one correct answer. The consequence is the need for a reductionist question.

Considering the topic of systems from a scientific point of view assumed (in the beginning of system theory) that a static and objectively applicable definition of system and structure could be found. Dealing with self-organization and evolution shifted the interests to the development of systems and the description of emergence. Emergence again states the observer in the focus of attention, which requires the *second order observer.* The scientific discussion within the research field of the *Complex Adaptive Systems* follows the principle of reduction with the determination of rules and patterns of order. The confrontation with emergence and the simulation of emergent processes shows a similar aspect in the results like Heisenberg's uncertainty principle in the first half of the 20th century for quantum mechanics. The necessary introduction of the *second order observer* as an observer of the monitoring process obviously shows, that circumstances of every scientifically based observation assuming factual truth are not determined and therefore are *uncertain* and blurred. This is confirmed by the wording of the *Truth of Fact* by Leibniz and the presumption of conjectural knowledge by Popper.

Every statement of absolute knowledge has to be questioned again. A statement marked as absolute, which is referred to be true within a specific knowledge system, can only be an indication of possible human knowledge for the *second order observer*. The causally related, mechanistic worldview within axiomatic limits requires no intention and suspends teleology from the sphere of natural science, as Thomas Nagel describes. [Nagel, 2013, p. 100] The confrontation with systems, complexity and emergence in the last decades of the 20th century finally found that an observer is necessary. This observer is able to recognize that the application of axioms and rules for recursive or iterative applications produces effects that can be described as non-deterministic. This finally leads to the situation, that the deterministic and causally related worldview despite all adopted determinations permits no chance of a calculation of future events.There is no prospective absolute in complex and emergent processes in which non-trivial systems participate.

Man, who wants to do science and analyze and predict the world, he is living in, indeed is intentional and aimed at a target. Assuming that a system that contains a single non-trivial element is considered to be non-trivial system, the conclusion seems to be evident, that a system in which one element is defined as intentional as a whole can be interpreted as intentional. In this context, however, it is not necessary to see science solely from the point of materialistic reductionism, but also how men will find and examine universally applicable principles.

Theories of systems, networks, complexity, emergence and the visualization of adaptive processes in the context of complex systems are able to give an impression of how relations and connections act. The statements of interdependencies based on reductionist findings with self-referential, iterative applications lead to a possible representation of regularity that can be interpreted as governance structures and thus as a new whole by an observer. The *second order observer* will note that recognized order structures correlate with the existing governance structures of the observer and thus with the expectation of the observer. This shows that structures within the applied monitoring systems determine the way of knowledge.

Applying the principle of the second order to concepts like knowledge, intention, aim and so on corresponds to the definition of *eigenvalues* of the processes being described. The aim of the objective of an observation process will make the real intention obvious. It should be noted that these processes are to be understood as non-teleological regarding the action of a superior entity, but may be seen as teleological with reference to the describing observer of the respective process. Every observer connects the definition of a target with his observation within a likewise targeted system.

The goal to do science may be interpreted in many ways (personal, social, socio-political, economic and so on). The main valid second order target always will contain the ability to make statements concerning the stable environment in order to predict future necessary adaptation processes in a timely manner and to conduct the necessary structural adjustment. (*„What physics is about is prediction. Basically to predict the future from the present or the future from the past“*. [Susskind,]). The knowledge of past and present demands observable aspects, that means stable and therefore measurable states. This denotes that only the combination of measurable data allows scientifically based derivatives and predictions. Use of this data predicting possible states of the environment and the resulting necessary adaptations to the system embedded in this environment shift the focus of attention to the relation between system and environment and their structural coupling. The second order observer principle – the observation of the observation – especially is postulated in science.

8. Aristotle’s *Mesotes* II

The above argued second order observer is able to see that the required qualitative assessment of Aristotle’s virtues needs an observer, who is excluded in the purely mathematical point of view. Moreover this second order observer is able to recognize, that all observers are human observers at the end and therefore can't be seen as trivial-machines.

Aristotle notes that excess and deficiency destroy the intended work, mediocrity, however, preserves it. [Aristoteles, 1975, II 1106b10f] The integration of acting into virtuous conduct requires a description of the progress within one time-dependent framework. Within that time-dependent process excess and deficiency influence each other complementary and thus aspire a stable middle. A mathematical representation of the processes occurring in the time dependencies could be represented as vibration or oscillation, which repeatedly approaches the observer-dependent center points from the different sides. Still there is no generally qualitative expression possible, so that the estimation of reaching the center by means of reflective introspection (*the second order observer)* is up to the observer. Only an observation of a group of people would allow the calculation of a statistical average, bringing a knock over from quality to quantityand could be mathematically diagrammed. The observer requires an increased number of elements for an abstraction of the middle course, whose relations lead to a statement called valid and objective.

This reflective introspection – the second order observer is able to see *mesotes* as an observer's description and therefore state the conclusion, that *mesotes* depends on the system and the structure the observer is embedded in. The definition of *mesotes* this way affords some kind of oscillation between reductionist exploration and the attempt to be able to see the world from the point of view of holism. This states *mesotes* as the principle observing complex relations and processes.

It can be assumed, that on the one hand the observer needs the ability to analyze systems and elements in a reductionist way to find patterns and rules.

On the other hand the second order observer needs reflective introspection to be able to recognize ethical needs. The question therefore cannot be which point of view to prefer – the challenge is the implementation of apparently contradictory points of view under the aspect of **as well . . . as**

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