DRESS, Andreas; HENDRICHS, Hubert; KÜPPERS, Günter (Eds.): **Selbstorganisation. Die Entstehung von Ordnung in Natur und Gesellschaft.** (Self-Organization. The origin of order in nature and society). München-Zürich: Piper 1986. 234p. ISBN 3-492-03077-7

The volume comprises the following nine articles (translated titles):

H.-P.Dürr: Recent developments in high-energy physics - the end of reductionism? -H.Haken, A.Wunderlin: Synergetics: Processes of self-organization in animate and inanimate nature. - B.Hess, M.Markus: Chemical clocks. - B.-O.Küppers: Science-philosophical aspects of the origin of life. - A.Gierer: Physics of the formation of biological shapes. - G.Wagner: Evolution of evolutionary capability. - G.Roth: Self-organization, self-preservation, - self-referentiality: Principles of the organization of living organisms and their consequences for the relationship between organism and environment. - H.Zwölfer: Insect complexes on thistles - a model for the self-organization of small ecological systems. -E.J.Schlicht: Economic theory with special reference to distribution theory, and synergetics.

Where does order come from? What are the rules that govern the formation of orderly arrangements - of "orders" - , their subsequent differentiation and their further development into systems of ever greater complexity? And finally: just what is "order" as the constituent process of life? The answers, both age-old and contemporary, range from the Old Testament Creator-God to a "Creation without a Creator" (Atkins). How is "order" to be understood as a social phenomenon, as the foundation of physical and mental health and, last not least, as the principle inherent in all order, the "order of order"?

Order is creative: it creates comparatively autonomous organizations and structures, worlds of cognition or action, environments and entities up to the conscious Ego - as autopoiesis hypothesizes. Higher, conscious orders are inseparably connected with the linguistic order, the order of knowledge through which experienced reality, the availability of knowledge, is only rendered possible in the first place.

This overlapping interrelationship needs to be taken into account in order to understand the hypothesis of self-organization for the formation of orderly arrangements, or more precisely: the series of hypotheses from various disciplines for a comprehension of the origination and variation of highly complex structures. Self-organization is concerned with the spontaneous origination of orderly systems, which process, without being predetermined in the classical sense, nevertheless is linked to describable prerequisites and follows identifiable rules. Self-organization tries to overcome the aporia into which rigid determinism on the one hand ("Order is that which is laid out in mechanistically interpreted laws") and a scientifically not verifiable faith in an elan vital must lead. Neither one is able to explain the core of highly complex structures: their adherence to laws of some kind and their variability - an ability no longer explainable by simple causality. However, it is only through these two characteristics that the preservation and further development of viable systems become possible in the first place. A more detailed description defines "self-organizing processes ... (as) those physico-chemical processes which within a more or less wide range of initial and boundary conditions occupy a precisely defined orderly condition or sequence of orderly conditions (boundary cycles). Such a condition or sequence of conditions may be understood as an attractor in the mathematical sense." (Roth, p.153-154).

Using a neurophysiological approach, Maturana and Varela understand self-organization as a cyclical process whose outcome, besides by the laws inherent in it, is co-determined by (stochastic) initial and boundary conditions. In all specialized definitions, however - be they of a physicochemical, biological or formal (mathematics, system theory) nature - one fundamental dimension is discernible: What prerequisites of human perception are presupposed in such a description of self-organization, and what others must be deduced from it?

So far for an introduction to the subject. Regrettably, however, this broad context is only sparingly - namely in a very few sentences and then predominantly from a natural-scientific point of view - referred to in the otherwise most readable foreword by the editors. The strength and, above all, the weakness of this collection of articles lie in its confinement to the relative importance of the self-organization concept to individual disciplines. This shortcoming is hardly balanced by the fact that even a discipline-centered approach will of necessity also lead to an interdisciplinary orientation, here e.g. in the contributions by Haken/Wunderlin for the scientific and by Roth for the biological aspect in a wider sense. A theme of such generality calls for rounding-off. It would be desirable if leading representatives of catastrophe theory (R.Thom), of general system theory (K.Boulder), of "Second order" cybernetics (v.Foerster, v.Glasersfeld), of autopoiesis and perception (H.Maturana, F.Varela) and of systemics in the form of a comprehensive ecology (F.Vester) had been more clearly called upon, if not directly, then at least in the form of a synopsis. Recommendable, in any event, is the contribution by Roth, which for all its brevity, presents an excellent overview of the central thinking-model of autopoiesis, i.e. the capability of self-preservation. A concept found missing is that of the netted or meshed ("vernetzte") system, which - not only in the German-speaking part of the world - is gaining in importance for ecological planning. The works of St.Beer on the steering system of viable systems should at least be referred to, particularly since law-like relationships, such as that of recursivity, the repetition of formally similar basic structures on various system levels, are developed here. E.J.Schlicht's very brief contribution on economic theory cannot make up for the absence of e.g. the approaches, already tested in practice, to self-organization developed at the University of St.Gallen, Switzerland (Ulrich, Malik, Probst, Gomez, et al.) The aforementioned Foreword should be expanded in this direction. All in all: the contributions fall short of living up to the overly ambitious title and sub-title.

This left aside, the competence of the contributions assures the reader, particularly if he or she is professionally interested in the subject, of a definite gain not only in terms of information of interest to his or her specific discipline, but also with regard to the insight gained into the re-orientation of thinking currently taking shape. To this extent this collection throws a bridge to the monographs already known, such as Haken's excellent presentation of the "secrets of nature's success" in his "Erfolgsgeheimnisse der Natur". The interdicsiplinary aspect is, furthermore, also emphasized

https://doi.org/10.5771/0943-7444-1987-3-168 https://www.inlibra.com/de/agb - Open Access -

in the contributions by Dürr (high-energy physics), Haken (synergetics) and Roth (self-organization, self-preservation, self-referentiality) for an intelligible presentation of autopoiesis; cf.also Giese's article on "Physics of biological shape formation".

A science-theoretical argument is put on by B.O.Küppers (Science-philosophical aspects of the origin of life). For a more thorough familiarization with the subject, his book "The Origin of Biological Information" (Piper 1986) can be recommended without reservation.

Using biological evolution as an example, B.O.Küppers shows that a profound epistemological change is currently manifesting itself in the concept of self-organization. (A pertinent overview is offered by "Der Exkurs des radikalen Konstruktivismus", ed.by. S.J. Schmidt, Suhrkamp Taschenbuch 1987). This development is also, if implicitly, referred to in the contributions by Roth (Self-referentiality) and, with limitations, Wagner (Evolution of evolutionary capability). Supplementarily thereto, it is worthwhile to work one's way through the positions, central for a classification of knowledge, of constructivism as retraceable to Maturana/Varela (neurophysiology). Put most briefly: the brain does not, through trial and error and in an essentially passive fashion, directly portray a correct, internal image of the environment. Rather, it builds up its internal representation of the environment in a process with cyclical feedback which actively and largely autonomouusly creates internal images. Against the background of this network - largely independent of immediate sensory impressions - of neuronal conditions, significance is ascribed to actual sensory impressions which, again in a clearly separate process, may provoke activity on the behavioral plane.

Physics rather than biology is the basic branch of science from which B.O.Küppers proceeds. He "... shows that even such highly complex structures as living organisms may be the result of non-directional natural processes in whose course inanimate matter spontaneously organizes itself into animate systems" (p.82). Of central significance here is the origination of - non-reducible - semantic-biological information: self-organization is to be antithetically understood as the epistemological-philosophical overcoming of reductionism. However, "the molecular theory of evolution only describes the general principles and mechanisms according to which biological information can come into being" (p.99), but not the semantic details of such information. These remain singular and open.

Wagner, finally, comes to grips with the system conditions of the evolutionary process. The evolutionary capability itself, i.e. the extent and spreading in time of the evolution steps, must be subject to evolution. Environmental variations are in large measure an active achievement of the organism (cf.Maturana/Varela) and are themselves, in turn, regulated genetically.

The superficially still predominant in the mechanistic-deterministic approach, as this argumentation makes clear, widens itself under the self-organization hypothesis to a probability-oriented outlook. More than any other set of explanatory models it compels one to realize that "thinking" means: to circumscribe units along significance-oriented lines, to interrelate them in a meaningful way and to assign significance to them. Thinking is a process which cyclically changes its own foundations, a process which self-referentially - under due observance of the initial and boundary conditions - develops out of itself.

The idea suggests itself to investigate what consequences might result from the above for the construction of classification systems of knowledge, e.g. along the lines of an auto-generic (Th.Ballmer, R.Ungvary) classification or an ontologically-based universal classification system (I.Dahlberg). What relations do the various classification concepts bear to self-organization? Or, even more fundamental: under what aspects can identification and classification be understood as self-referential, recursive, cyclical processes?

A few suggestions, selected from the point of view of system research, are presented below. They are intended as invitations to exploit the stimulative contributions furnished by self-organization and radical constructivism to classification theory as necessary impulses for the further development of classification:

- Process over structure: the order-formation process as an ordering principle over representations of conditions.
- Self-referential orderly arrangements: cyclical feedback for further development. Relative autonomy of classifications of knowledge.
- The primacy of constitutive, life-preserving basic structures ("organization" as meant by Maturana/Varela).
- Extent and sequence: Origin, preservation and change of referential spaces. Sequence of processes. Intermeshing ("Vernetzung").
- Space and time: Differentiation according to the polar concepts of chronos and kairos, of topos and choros.
- Symmetry and symmetry breaks in the principles of the classification of knowledge.
- Law-like relationships and the influence of initial and boundary conditions (e.g.R.Ungvary); universal and local influences on orderly arrangements.
- Differentiation between micro, medium and macro-levels: probability fields, properties, shape qualities as classification categories.
- Is a self-referential classification of knowledge, capable of evolution and corresponding to the criteria for self-organization, imaginable - and if so, under what limitations?

Despite the mosaic-like articles, each covering only a limited sector, the book under review is well worth reading as a stimulus to further, more detailed study of the subject. Well readable throughout as it is - which, given the complexity of the subject matter, is anything but a matter of course - it will find appreciation among broader circles of readers, too. This property - let us single out the exemplarily lucid text of Haken/Wunderlich -may be expected to contribute to a - most desirable - dissemination of the body of thought of self-organization over and beyond the restricted scholarly circle, without getting dangerously close to the New Age publications in the strict sense.

What has been under discussion since the mid-70's in the interdisciplinary area of sciences - also in a broader sense - should now also become accessible, in a scholarly fashion, to the realm of pre-scientific discussion. Too

https://doi.org/10.5771/0943-7444-1987-3-168 https://www.inlibra.com/de/agb - Open Access -

incisively has not only our image of the world, but also our understanding of ourselves been affected. In the - initially limited - science-theoretical field, an expansion of the strictly circumscribed and - for good reason - ethically indifferent and non-significant postulate of science is heralding itself, which expansion is paving the way toward a classification of knowledge which already in its rudimentary stage is oriented toward properly-understood preservation and conservation. At the - considerable - risk of being misunderstood: the problems currently presenting themselves can only then, in their totality, be tackled in a meaningful way if we interrelate the objects of our thinking in a comprehensive, overlapping fashion.

The work's subtitle: "The origin of order in nature and society" - to be understood as a suggestion rather than as a claim - may contribute to this end.

Helmut Löckenhoff

Dr.H.Löckenhoff, Ossietzkystr. 14, D-7150 Backnang

MATURANA, Humberto; VARELA, Francisco: **Der Baum der Erkenntnis. Die biologischen Wurzeln des menschlichen Erkennens.** (The tree of cognition. The biological roots of human cognition). Bern-München-Wien: Scherz-Verlag 1987. 280 p., DM 44.- ISBN 3-501-13440-5. Transl.from Spanish (El arbol del conocimiento) by Kurt Ludewig.

(Vorbemerkung der Redaktion: Dies ist die gekürzte Fassung einer ausführlichen Besprechung, die wir unseren Lesern auf Anfrage gerne zugänglich machen.)

Mit der Untersuchung der - so der Untertitel - "biologischen Wurzeln des Erkennens" ist ein Thema angeschlagen, das wie kein anderes unsere Existenz unmittelbar betrifft: in den geistigen Grundlagen ebenso wie in der praktischen Lebensgestaltung; individuell, sozial und ökologisch. Im "Baum der Erkenntnis" bieten die chilenischen Systembiologen Maturana und Varela nicht nur einen übersichtlichen Zugang zum Ergebnis ihrer weltweit wegweisenden Forschungen. In ihm entfaltet sich eine Differenzierung des bisher vorherrschend unzulässig vereinfachenden Denkens, die mit einer kopernikanischen Wende verglichen wurde. Es wird hier eine Antwort auf die Frage nach Natur und biologischer Geschichte menschlichen Erkennens gegeben: Der Baum der Erkenntnis aus der biblischen Geschichte wird zur Metapher: der Leser wird "eingeladen, von der Frucht dieses Baumes zu essen, indem wir ihm eine wissenschaftliche Untersuchung der Erkenntnis als biologisches Phänomen vorgelegt haben" (S.263).

Maturana und Varela versuchen in einfachen und eindringlichen Bildern, eine persönliche Anwort. Erkennen ist, so zeigen sie, Ergebnis einer historischen Entwicklung in struktureller Kopplung mit den Umfeldern und zugleich autonom in einer für jedes Subjekt einzigartigen, nur indirekt von Umwelteinflüssen abhängigen inneren Repräsentation dieses Umfeldes. Jeder Mensch hat seine eigene Welt, fähig zur strukturellen Kopplung mit den Welten der Mitmenschen und doch in der Wertsetzung innerhalb so vorgegebener Möglichkeitsfelder eigenständig. Sein Bewußtsein ist beeinflußt durch die Regeln der Koevolution wie durch individuelle Lernprozesse, und doch in der Setzung der Vorränge in diesem Rahmen unmittelbar. Anders als das rationalistische scheint dieses Konzept geeignet, Grundlage für ein überzeugendes, weil nichtdeterministisches Verständnis der anstehenden Probleme und für deren systemische, d.i. nichtlineare und deshalb nicht potentiell selbstzerstörerische Weise ihrer Lösung zu sein. Ein Verständnis, das fähig ist zu "lernenden" Arten der Problemlösung, die während des Lösungsprozesses vorher nicht geplante und nicht planbare Wirkungen berücksichtigen, weil es in nichtreduktionistischer Form Erkennen und Tun, Erkennen und soziale Bindung, Erkennen und ökologische Verantwortung als komplementäre Seiten eines evolutiven Prozesses begreift.

Der "Baum der Erkenntnis" versucht einen Brückenschlag, will also nicht eine bloße Gegenposition zum rationalischen oder ideologischen Standpunkt aufbauen. Am Ausgang stehen naturwissenschaftliche Experimente und solchermaßen nachvollziehbare Ergebnisse. Sie allerdings führen zu Schlüssen, beispielsweise beim Farbensehen oder bei der Koordination des Fliegenfangens beim Frosch, die mit einem deterministischen Weltbild nicht zu vereinbaren sind. Es gibt eben keine direkte Reiz-Reaktion-Verbindung zwischen der Umwelt und ihrer internen Repräsentation für die Wahrnehmung und Erkenntnis. Der Geist und sein Gehirn, um eine Wendung von Popper/Eccles zu übernehmen, hat seine ureigenen Vorstellungen von seiner Welt. Das wichtigste konstituierende Merkmal eines lebensfähigen Systems (Stafford Beer) ist in diesem Kontext die Autopoiese. (Autopoiese ist eine Begriffs- und Benennungsschöpfung der Autoren, im Buch durch "Selbsterzeugung" - einschließlich der Selbsterhaltung - übersetzt übersetzt. Ein dergestalt autopoietisches System hat, ontogenetisch und phylogenetisch seinen eigenen Zustand intern und im Verhältnis zur Umwelt in internen neurologischen Konfigurationen repräsentiert. Jeder neue Reiz wird von diesem Muster auf seine Bedeutung für das System gewertet und löst gegebenenfalls Verhalten aus, die vorgegebene neuronale Zustände im Sinne der Autopoiese konstant halten. Individuelles und soziales Verhalten, Lernen und Sozialisation, Einstellung zu Umwelt und Werkzeuggebrauch, alle Methoden der hier nicht mehr im rationalistischen Sinne aufzufassenden Problemlösung werden so in differenzierterer Weise verständlich. Nur reales Verhalten ermöglicht Erkennen und umgekehrt: E r k e n n e n i s t T u n . Sehr vereinfacht läuft diese Sichtweise darauf hinaus, dem betrachteten System einen hohen Grad an Autonomie gegenüber Außeneinflüssen, d.i. ihrer Bewertung und Beantwortung durch entsprechendes Verhalten zuzuweisen, eben dergestalt, daß es zum selbsttätigen - siehe oben - Aufbau und zur Erhaltung seiner konstituierenden Strukturen befähigt wird. Wieweit und unter welchen Voraussetzungen dieses aus den Vorgängen in einer einzelnen Zelle gewonnene Konzept auf mehrzellige und auch auf soziale (metazelluläre) Systeme übertragen werden kann, welche Unterscheidungen dann erforderlich werden, bliebe eingehend zu untersuchen.

Die Anfangssätze im Vorwort intonieren Ausgang und Thema: es geht um eine "Biologie des Verständnisses". Die Autoren erheben den Anspruch eines vollständigen Entwurfs für einen alternativen Ansatz zum Verständnis

https://doi.org/10.5771/0943-7444-1987-3-188 https://www.inlibra.com/de/agb - Open Access -