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The Difference between *Communication and Interaction* as the Constitution of Life

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1. Introduction

A central characteristic of modern western culture is undoubtedly the triumphant success of Natural Sciences since the 17th century. Primary applied in the context of *matter*, this scientific method became also importance in research fields of living entities during the further progression of the modern era, especially in relation with the prevalence of molecular biology in the second half of the 20th century. The thereby associated reductionistic perspective of life was advantaged on the basis of René Descartes strict differentiation between *mind (res cogitans)* and *matter (res extensa)*, without consideration of life (*res vivens*) as a distinct dimension of reality. Because of that the mechanistic frame of thinking could become so dominant not only in Sciences but also in everyday life. In our contribution – based on central insights of quantum physics and communication theory – we try to show, that living entities cannot be fully accounted in terms of the principles and laws of physics and chemistry alone. With help by the fundamental differentiation between (physico-chemical) *interaction* and (behavior-variable) *communication* should be argued and pointed out the constitutive characteristic of all living entities: *dialogical relationship*.

2. The essentiality of life organ – *Is it reducible to physico-chemical interaction?*

I would like to start with a consideration of the well-known Swiss biologist Adolf Portmann (1897–1982), with his essay *Biology and the phenomenon of mind*.¹ There he reminds us, that we can't realize *living* phenomena without a specific understanding of *mind*. In this context he differentiates between two

¹ Portmann 1948. See References.

groups of phenomena: On the one hand the fullness and variety of *human life*, directed by an entity called *mind*. On the other hand – to differ from human individual mind – the “realm of mind”, standing for a sphere over – or beyond natural things and phenomena. You would not demand from a biologist – Portmann analogously – that he decides in which relation individual human life/mind and the “transindividual” realm of life/mind is connected. For the moment just one point is important to differentiate between these two meanings: *individual human mind* and *realm of mind*.

Against this background Portmann postulates, that biology has – at first – to abandon strictly from presupposed world-views or philosophies of life or mind. Both are from the view, that *mind* is a break-in from a foreign sphere into earthly forms of living, regardless if the idea is well-grounded philosophical or theological; as well as from the preconceived opinion, mind is the evolutionary result of life – like a fruit as the outcome of vegetation.

Both are – according to Portmann – presupposed positions: In one context mind is just a (scientific research detracted) epi-phenomenon of life (and matter) as in the other context – in a uniform manner – (mind is) self-evident and totally integrated.

Portmann said literally²: “What Life-Sciences can say to the phenomenon of mind, cannot be determined in advance, it is to expect, that remains to be seen.”

In this sense, Portmann looked – as far as possible without any philosophical preconditions – at the *manifestations* of life. I.e.: In regard on a *phenomenological* way, how does life appears, how does it presents as it is. With regard of Wilhelm Roux (1850–1924) he numerates in his book “*At the Border of Knowledge*” (1974)³ at first the following – not controversial – specific elements of living entities: *metabolism, growth, motility, reproduction, heredity, development*. Then he added, that all familiar definitions of life lacks something hardly explicable in words: the element of *inwardness*, an essential quality for understanding all living entities – in Roux’s and Portmann’s view. In this respect all forms of the living are characterized by the ability to “*self-expression*”, in many

² Portmann 1948, p. 163.

³ The original title in German: *An den Grenzen des Wissens. Vom Beitrag der Biologie zu einem neuen Weltbild*. Wien-Düsseldorf 1994.

and different ways. Or to say it in other words: All living entities are able to *communicate* – they have “communicative competence”.

Not exceptionally in this sense it is evident, that – as Günter Tembrock postulates already 1970 in his book “*Biokommunikation*” (*biocommunication*) – the possibility (and necessity) to *change information* is one of the ultimate basic principles of all life processes.

That means: There is no information exchange *between* computers (or other kinds of natural as well as cultural abiotic entities), but there is information exchange *with support* of computers (or other kinds of natural as well as cultural abiotic entities); because information is always information from *someone* to *someone*, never from *somewhat* to *somewhat*. With the words of Bolz⁴: “Answer doesn’t mean reaction. A stimulus tells no question, and a cybernetic machine isn’t able to reduce a *réponse* to a *response*.” That is: Information-exchange needs not only (natural-necessary) physico-chemical *interactions* but also (behavior- or acting-variable) *communication*; in short: freedom of behavior and action.

That is the main message of this essay: **(physico-chemical) interaction ≠ (bio-) communication.**

3. *Physico-chemical interaction versus Bio-communication*

For the explanation of this concept in detail I will turn back at first to the year 1970.

It can be denoted as one of the loveliest ironies in scientific history that Francis Crick published his paper declaring the central dogma of molecular biology (“information flow” from DNA → RNA → protein) in “*Nature* 227”⁵, one number *after* the “scientific outlaw” in which Howard Martin Temin and his partner Mizutani (Temin / Mizutani 1970) described a central-dogma-breaking genetic activity: *reverse transcriptase*, – the possibility of an “information flow” from RNA → DNA.

⁴ Bolz 1990, p. 141.

⁵ Crick 1970.

As we know nowadays, this was a major finding to understand the “dynamic stability” of the genome, the circumstance, that the genome within living entities is incorporated in a permanent process of adaptation and (re-)configuration, which is indispensable for its solid stability. This permanent process/activity of genome’s adaptation and (re-)configuration – from Shapiro named “Natural Genetic Engineering”⁶ – requires in its essence a “post-reductionist” understanding, inasmuch as it focuses especially on bio-communicative acts.

In this context *interaction* means – as above mentioned – a natural-necessary physico-chemical process *without* degrees of freedom (variability of behavior). *Communication* stands – in contrast – for an event, based on acting “subjects”, connected *with* degrees of freedom (variability of behavior or acting).

Let me illustrate this life-specific “communication competence” by pointing out a special even paradox situation where it is – for humans – forbidden to communicate. I owe this example the physicist Herbert Pietschmann. He calls it “Checklist-behavior in cases of emergency in air-traffic”. Pietschmann points out, that it is reasonable – under special circumstances, mainly in cases of emergency in air traffic – to “communicate (quasi-)interactional”, that means: to follow absolute strictly the checklist’s instructions. In other words: just *not* to use the human communicative potential of variable acting⁷

However this example of reducing human-communication to “quasi-interaction” shows the difference between both. With help by this fundamental differentiation should be argued and pointed out the constitutive characteristic of all living entities: *dialogical relationship*⁸.

But please keep in mind: No communication (equal human- or any type of bio-communication) *without* physico-chemical interaction. That is the reason, why it is/was possible, to reduce communication to – nothing but – a complexity of physico-chemical interactions. This reductionist understanding of life was established with the second half of the 19th century. Why that?

⁶ See: Shapiro 1993.

⁷ See: Pietschmann 2016, pp. 26–28.

⁸ See in detail: Hamberger/Pietschmann 2015, pp. 306–309.

4. The “Modern frame of thinking” based on Natural Science

It depends on the development of the – from Pietschmann⁹ called – “Modern frame of thinking” with the four central pillars: 1) to measure everything (Galileo); 2) to break everything into smallest pieces (Descartes); 3) to differentiate always ‘either – or’ (Aristotle) and 4) to find always a cause (Newton).

These central and characteristic scientific elements are undoubtedly responsible for the triumphant success of Natural Sciences since the 17th century in Western Culture – and now all over the world; because of the unexpected prosperity, the scientific method – primary applied in the context of *matter* – became accordingly importance also in research fields of living entities during the further progression of the modern era. Very important in this context: Descartes only differentiated between matter and mind (*res extensa* and *res cogitans*) not between matter, *life* and mind. Because of that – in his sense – animals are basically not to differ from abiotic entities (mechanisms)! So Spaemann points out¹⁰: “There is for Descartes no special realm of life between the realm of mind and the realm of dead, passive matter.”

Krings describes this process as follows¹¹: “Man discovered [in Western Modernity] the possibility of explaining [living] nature as a series of [interactional] events. In order to take advantage of this opportunity, however, [living] nature had to be silenced. It was successfully silenced, and the door was thus opened for explanations. The result is that it is impossible to precisely determine whether [living] nature is actually speaking: the very fact that it is not speaking is the prerequisite for the precise determination.”

In other words, Krings makes it clear, that modern science established a cognition-milieu, according to that also *living* (and *human*) entities had to be researched under the criteria of the a-biotic. Not later than with Descartes *Discours de la méthode* (1637) and Newtons *Principia Mathematica* (1687) the concept of cognition changed from a (word focused) transcendental structure with a “top-down” cognition model to a (wordless/number focused) mechanistic interpretation of the reality based on a “bottom-up” understanding of cognition,

⁹ Pietschmann, 2016, p. 25.

¹⁰ Spaemann 2010, p. 83.

¹¹ Krings 1982, p. 391.

first established in a-biotic natural sciences (physics and chemistry). This is not the place to describe in detail the process from the early days of modern science, when biology was not an experimentally but an observantly empiric science and morphology was the central cognition aspect of biological and zoological research, with the first aim to understand a type as a living-configuration as a whole¹².

Anyhow with the 20th century not only the scientific area medicine but also the classical life sciences zoology and biology were increasingly focused on the different functional part-areas of the living with the purpose to be able to understand better/decode the mechanism "life" by understanding the single parts of it. An important consequence of this was, that the targets of scientific research – also in molecular biology and genetics – become more and more difficult to illustrate. But it was – according to the analytic cognition concept of modern science – at least static targets. That means: They are basically constant and could be researched analogous to abiotic/inorganic cognition "subjects" in physics and chemistry. This fact leads to the tendency, to understand biotic/organic processes also in a mechanistic way. In other words: As well these research areas, which are specially focus on living processes, are in danger to understand living entities out of non-living entities with the result, that they lose the ability to see its specific lively subject of research.

In short: It is important to mention, that the mechanistic interpretation of the scientific Modernity reached over the years more and more not only the Inorganic but also the Living. In this cognition context, which is closely linked to the elements of logical consistency, definiteness and causality – following Aristotelian logic – mathematics/(wordless) *number* became a central cognition tool. This tendency of the cognition-turn from *word* (logos) to *number* illustrates Ulrich with the remark as below¹³: "The permanent occupation with the world of the lifeless [in the scientific-cultural context of the Western Modernity] has formed kinds of view and thinking, which are similar to it."

Especially after formulating the central dogma of molecular biology in 1953 researchers of living entities focuses their attention more and more on *non*-living parts of living entities. According to this, Löw writes in his book *Die Philoso-*

¹² Wilson 1995.

¹³ Ulrich 1979, p. 9.

*phie des Lebendigen (The Philosophy of the Living)*¹⁴: “Biology, the science of Life, is defined by the effort, to reduce the Living to the Death”.

So researchers like Jakob von Uexküll (1864–1944) and others couldn't influence the development of biological sciences in a relevant way for a long time. The problem of actual biological thinking is, in my opinion that – as Ulrich remarks – the fundamental difference between the sentences¹⁵: “‘Life-processes are physico-chemical proceedings’ and ‘Life-processes are *nothing but* physico-chemical proceedings’ is still not accepted.”

5. *Opponents to the Natural Science Centric View*

But there are visionary outsiders like Barbara McClintock. She wrote already in the 1980ies the sentence: “A goal for the future would be to determine the extent of knowledge the cell has of itself, and how it utilizes this knowledge in a ‘thoughtful’ manner when challenged.”¹⁶

With the following quote McClintock refers not only to the circumstance, that cells are able to *sense* and to activate mechanisms, but also that they are able to bring together e.g. ruptured ends of chromosomes by *directing* them to each other and to *unite* them in a correctly way; that means the ability of cells to *realize all* that is going on within them, to have a “cell-world-view”.

“The conclusion seems inescapable that cells are able to sense the presence in nuclei of ruptured ends of chromosomes, and then to activate a mechanism that will bring together and then unite these ends, one with another. And this will occur regardless of the initial distance in a telophase nucleus that separated the ruptured ends. The ability of a cell to sense these broken ends, to direct them toward each other, and then to unite them so that the union of the two DNA strands is correctly oriented, is a particularly revealing example of the sensitivity of cells to all that is going on within them.”¹⁷

Trevavas writes in an analogous manner, citing the above shown quote from McClintock in his paper *Plant Intelligence*: “This statement was made by the

¹⁴ Löw 1980, p. 27.

¹⁵ Ulrich 1979, p. 11.

¹⁶ Mc Clintock 1984, p. 799.

¹⁷ Mc Clintock 1984.

plant biologist Barbara McClintock, in her Nobel Prize acceptance speech. It can be rephrased as following: 'A goal for the future would be to determine the structure of the current integrated molecular network of the cell resulting from development and environmental experience (memory) and how that networks acts to intelligently generate successful adaptive responses when challenged.' McClintock's statement is a plea for better understanding of signal interpretation or signal transduction (challenge), how cells 'know' both their stage of development and how it has been modified by environmental signals and finally how thoughtful (intelligent) behaviour is used to improve fitness through adaptive responses."¹⁸ To the end of the article he remarks: "The examples provided in this article indicate that plants are capable of detailed sensory perception, information-processing and integration, decision making, and the control of behaviour, learning, memory, choice, self-recognition, foresight by predictive modelling and computation to efficiently sequester resources. The question then arises as to why these have not been recognized earlier."¹⁹

In this sense Portmann developed in the 1960ies (Portmann 1960, 1969, 1990) a concept of organic self-representation, wherein he considered the outer surface of living organisms as a specific organ that plays a self-representational role.

Kleisner described Portmann's conceptual framework – which is widely ignored in biological research so far – in a current paper in short as following: "Portmann's central idea can be formulated as follows: the outermost surface of an organism is a manifestation of *phenomena proper*²⁰ that arises within the pro-

¹⁸ Trevavas 2005, p. 401.

¹⁹ Trevavas 2005, p. 410.

²⁰ The term *phenomena proper* remarks Kleisner (2008, 209) in detail as following: "Phenomena proper (*eigentliche Erscheinungen*) represent the entire outer aspect of an organism that may potentially stimulate the senses of another living being, that is, those aspects of the organism which are exposed to the perception of another subject in natural, non-invasive, way. For example, the various colorations, ornaments, coat patterns and other morphological features of the outermost organismal surface are considered to be manifestations of *phenomena proper* within the realm of sight. Although Portmann focused primary on vision, *phenomena proper* comprise many other expressions of life (i.e. behavioural, olfactory, acoustic, tactile etc.). Nevertheless, there are also other dimensions of an organism, which are naturally concealed from the senses. All organs and organ systems that are not immediately apparent from the outside – typically inner structures that ensure the energetic and the mechanical functioning of the organic whole – belong to this category and were marked by Portmann as *phenomena improper* (*uneigentliche Erscheinungen*). In contrast to *phenomena proper*, *improper phenomena* are not primarily intended to arouse the sensation of another organic subject."

cess of *self-representation* of organic *inwardness*. ... All phenomena proper serve to present the *self*, rising up from the inwardness of a living being, which can be understood as a particular form of organic self-experience.”²¹

I see the topicality and the importance of Portmanns concept for a bio-communicative approach especially in his idea, that the outermost aspect of a living organism opens a cognition-way to the innermost dimensions, because -- in his view -- surface manifestations are reflections of the inner selfhood of every living being, and this can bring us to a closer understanding of living entities.²²

And Sidney Brenner quasi assists with the statement²³: “If we want to effectively simulate cells or even organisms, then we have to learn to understand not only the vocabulary of machine language, but we have also to observe what we call the grammar of a biological system. We have to be absolutely clear in our minds ... how cells or an organism transmit the information.”

These quotations, two from Nobel laureates, show -- according to my opinion -- that there is an actual need for a new understanding of living processes/acts, based on the ability I have called “*bio-communicative competence*”.

6. Ferdinand Ebner and his Contribution for Communication Theory

In the following paragraphs I will present the main features of a “bio-communication-approach” in regard on the basic thought of a widely unknown Austrian language philosopher, Ferdinand Ebner (1882–1931), to present an idea which is probably helpful for the discussed topic.²⁴

Before presenting Ebners path breaking basic thought, I am going to point out his vita in short. Ferdinand Ebner was born in Wiener Neustadt (Lower Austria) in 1882. After his education he worked for 22 years as a primary school teacher in Lower Austria (near Vienna), until his earlyretirement caused by chronic illness in 1923. He died in 1931 on lung tuberculosis. Ebner published just one

²¹ Kleisner 2008, p. 209.

²² See Portmann 1969, p. 315.

²³ Brenner 2002, p. 32.

²⁴ For an introduction into the framework of Ebner see especially Evers 1979 and Wucherer-Huldenfeld 1985.

book: *Das Wort und die geistigen Realitäten. Pneumatologische Fragmente (The Word and the Spiritual Realities. Pneumatological Fragments)*²⁵.

In the meanwhile this opus is noted as one of the key works of dialogical philosophy in the early

1920s. In a widely noticed article from Horwitz (1985) becomes evidence, that Ebner's thoughts had influenced amongst others the thinking of Martin Buber, especially his well-known book *I and Thou* (1923). In the following it should be presented – in a little bit shortened version – Ebner's basic thought, formulated from himself as introduction to his above mentioned main work.

“Given, that the human existence has in its essential an immaterial meaning;

Given, that one can dare to speak about something immaterial *in* man, so this is essentially characterized by the circumstance, that it is fundamentally applied to a relation to something immaterial *apart* from it, *through* and *in* which it exists.

An expression, namely the ‘objective’ comprehensible and so the accessible expression for an objective cognition can be found in the fact, that man is a *speaking* being, that man ‘has the word’. ...

If we now, to have a word for that, call this immaterial *in* man I, the immaterial *besides* man – in relation to which the >I< exists – Thou, then we have to keep in mind, that this I and that Thou are given *through* the word and *in* it, in its >inwardness<.

But they (I and Thou) are not given as blank words, where no reference to a reality is inherent; ... rather [they are given] as word, which >reduplicates< its >substance< and reality-content in the actuality of its being spoken in the concrete situation which is created by the speaking. This is in brief the fundamental idea.”²⁶

The basic thought shows unquestionable: for Ebner human being is – contrary to most of the philosophical conceptions in Western (Post-)Modernity – based not on an autonomous self or I but on *relation*. In this sense Bergman notes²⁷ to the thinking of Ebner: “Self-consciousness is made possible only by the relationship of affinity between ‘I – Thou’. In other words, by the ‘I’ insofar as it is spoken to. I am rational, capable of understanding – I am a *person* – by virtue of

²⁵ Ebner 2009 [1921]. Unfortunately is this major work of dialogical philosophy till this day (2017) not translated into English.

²⁶ Ebner 1963, p. 80f.

²⁷ Bergman 1991, p. 158.

there being someone who speaks to me. Spiritual life is personal life. Reason, logos and the word signify an attitude of openness toward the 'Thou'. This kinship between 'I' and 'Thou' makes human society possible."

With this concept Ebner is totally opposed to the "Self"-concepts of the idealism (e.g. Schelling, Fichte). According to their thoughts there was first an 'I' and then came a 'You' as a supplement. The idealists forget - in the sense of Ebner - that 'I am' is impossible without 'You are'. The influence of Soren Kierkegaard (1813-1855) to Ebner's thinking is evident, especially in regard to Kierkegaard's conception of the human *self*, pointed out in his book *Sickness Unto Death*. There we find the definition: "The self is a relation that relates itself to itself."²⁸ That is, the human being is -- in principle, not only in a secondary aspect -- a synthesis, a relation between two.

But man can cut this fundamental bridge between 'I' and 'Thou', he can live in what Ebner called the *solitude of the 'I'* (Ich-Einsamkeit, Du-Verschlossenheit). And Ebner finds in mathematics and modern natural sciences an expression of self-isolation. Bergman writes to this topic²⁹: "Mathematical thinking is rooted, in his [Ebner's] opinion, in the solitude of the self. This view apparently derives from the fact that the exact natural sciences seek to dominate the world and relate to it as though it were made up of dead matter."

Now I try to adapt the above shown basic thought of Ferdinand Ebner to the phenomenon of *life*:

Given, that *live* basically represents at all an "epi-mechanistic" phenomenon. Given, that one can dare to speak about something "internal" in living entities, so this inwardness is elementary characterized by its basic application to a relation to something internal *outside* of it, *through* which and *in* which it exists.

An expression, namely the objective-comprehensible and because of that one with access to an objective cognition is to be seen in the fact that living entities are connected with the ability to bio-communication, i.e. the ability to interact word/language-analogous respectively that all kind of living *itself is* "word".

²⁸ Kierkegaard 1980, p. 13.

²⁹ Bergman 1991, p. 158.

If we now, to have a word for that, call this “epi-mechanistic” *in* the living “identity” or “self”; but the *outside* of it – in relation to which it exists – *co-inwardness*, then we have to keep in mind, that this “co-inwardness” is given just through the connecting *word* and *in* it, in sharing of its inwardness.

“Identity” and “co-inwardness” are not given as constructed abstraction, where no reference to a reality is inherent; rather as *word*, which “reduplicates” its “substance” and reality-content in the actuality of its bio-communication, in the situation which is created by the concrete act of bio-communication.

This is in brief the modified fundamental idea from Ebner, adapted to the biological phenomenon of life.³⁰ But how we can use it for biological research? For a bio-communication-approach?

7. *Application of Ebner's Theory – Contribution for “bio-communicative” Relation in a Contemporary World*

If it is a goal for the bio-scientific future – citing again Barbara McClintock³¹ – “to determine the extent of knowledge the cell has of itself, and how it utilizes this knowledge in thoughtful manner when challenged”, then we have to look for an understanding of communication in the context of the living, which is not primarily orientated on the mathematical theory of communication³², but on a word-analogous meaning of communication, especially developed by linguists, language philosophers and (human) communication researchers.

According to this background it seems to be an actual need to a transdisciplinary dialogue between the Life Sciences and language philosophy, linguistics and human communication research. Given, that McClintock and others are right, that biological systems and processes/acts “cannot be fully accounted for in terms of the principles and laws of *physics* and *chemistry* alone”³³, and I want to add: also not alone in terms of a mathematical/mechanistic understanding of

³⁰ See: Hamberger 2012.

³¹ McClintock 1984, p. 799.

³² See: Shannon & Weaver 1972.

³³ Ji 1999, p. 411.

communication: the empirical data tends more and more in this direction³⁴ ... than we are constrained to look for a new approach to understand *biocommunication* in a relevant way.

What Hanahan and Weinberg remark in the context of cancer research, seems to be valid for all areas of biological research: “Researching the cancer problem will be practicing a dramatically new type of science that we have experienced over the past 25 years. Surely much of this change will be apparent at the technical level. But ultimately, the more fundamental change will be conceptual.”³⁵

According to this fact it seems to be an urgent need for a cross-disciplinary/transdisciplinary scientific dialogue especially between (bio-)physics, biology, communication science and language philosophy that could be helpful for all dialogue participants³⁶. Trosko points out³⁷ the “actual climate” of biological research in a lively and – at the same time – discrete manner as following, opening a window for an upcoming new paradigm of Life Sciences: “There comes a time in every scientific discipline that the current paradigm is no longer capable of adequately explaining new observations or the old paradigm, via its past success, opens up new insights that allow one to modify the paradigm to integrate into new disciplines.”

As a result of this the current “bio-mechanistic” paradigm seems no longer capable, because more and more empirical data and observations show with increasingly evidence, that “*live*” (in sense of *living life*) – in all its manifestations – is not only a *dynamic process*, it is always – at the same time – *someone* with an “identity”³⁸, and therefore with the ability for bio-communication.

In this sense I will end with the modification of a well-known sentence from Theodosius Dobzhansky: *Nothing in Biology makes sense except in the light of (bio-)communication*.³⁹

³⁴ See: Bassler 1999, Van de Vijwer 2002, Plaetzer & Thomas 2005, Ben Jacob & Levine 2006, Witzany 2000, Witzany 2007, Von Hagen 2015.

³⁵ Hanahan & Weinberg 2000 cited by Trosko 2004, p. 193.

³⁶ See: Hamberger 2004.

³⁷ Trosko 2007, p. 93.

³⁸ See Pöltner 2005, pp. 110–112.

³⁹ The original sentence of Dobzhansky says: “Nothing in Biology makes sense except in the light of evolution.”

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