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Proposal for A Systemic Human Ecological Turn for Health Science and Medicine

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ABSTRACT: Industrial development processes, accompanied by extreme growth processes, regards world population, pollution, food production and the exploitation of natural resources have caused severe ecological problems. This has been well known since 1972 through the study 'The Limits to Growth', in which humanity and the world society was called upon to make an ecological turn and to change its consumption model and the type of economic development that was not suited to finite natural resources (or a finite planet). However, the relationships between the state of the environment and human health have hardly been considered, although an ecological view of health was already proposed by Hippocrates, and as in the meantime, the technical terms "Environmental Health" and "Environmental Medicine" have become established at universities. It is only in recent times that global terms such as climate medicine, One Health, Eco Health, etc. have become powerful pragmatic and action-oriented initiatives. They can be understood as calls for a worldwide health-related 'ecologization' of (health) culture. Regarding these approaches we highlight theoretical and metatheoretical aspects, since in general, any real action is only as good as the analytical quality of the plan that serves as a guide for that action. From this point of view, we find that these approaches exhibit graving weaknesses. These are, among other things: the neglect of epistemological challenges combined with inconsistent conceptualizations of the category environment, the very superficial models of human beings, weaknesses of ecological frameworks in relation to the macro-, meso- and micro-eco-social levels of the targeted topics, and a vague notion of systems methodology. Following on from this, we call for an explicit social-/human-ecological framework (New Viennese School, Australian School) for environmental health issues as it has been established for decades in the field of environmental, sustainability and transformation sciences.

Keywords: Global environmental health initiatives; Human ecology; Anthropological medicine; Transdisciplinary knowledge integration; Systems thinking

1. Introduction: Environmental Disturbances by the Unlimited Industrialization Program

It is widely accepted that the main driver of global environmental burden is primarily caused by industrialization and globalization, which can be characterized by the paradigm of unlimited growth processes. These processes are based on an increase in consumption and the search for new technologies. The negative ecological effects of these processes have been known at least since 1972 by the study 'The Limits to Growth', which was initiated by the Club of Rome and conducted by a research team from the Massachusetts Institute of Technology, supervised by Jay W. Forrester [1]. This study implicitly called "the world society" for an ecological turnaround. It has been discussed worldwide for over 50 years now, but relatively little has changed during the last decades. Some 35 years later, the scientific publication on the "planetary boundaries" raised international attention by introducing nine dimensions of ecological relevance [2,3]. In six of the nine dimensions, the boundaries are transgressed, according to present analyses [4]. Shortly later, after the first publication on the planetary boundaries, the UN called for a global 'sustainability' turn of our civilization and propagated 17 explicit "Sustainable Development Goals" and 169 sub-goals (SDGs; [5]): poverty reduction, food security, improving health and increasing education are the first four goals, followed by 13 more goals for the further development of human civilization. Some progress is made, some not. In 2023, at COP 28 a world wide discussion to fight climate change was organized with good, but relatively poor international commitments, showing the conflicts of

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interests related to industrialized collective life styles (the so-called "imperial mode of living") and the goals of fossil energy carrier producing organizations [6]. But it has to be noted briefly here, that this kind of civilization program has brought prospertiy to industrialized countries in the Northwest and, more recently, the Northeast, but has also exhausted and damaged nature and societies in the Global South [7].

In consequence, however, it becomes clear that environmental degradation is caused to a large extend by industrialization, which is based on economic pressures to maximize profits. If industrialization is the main cause of environmental problems, an improvement in environmental conditions implies an ecological turn in modern industrialized cultures—there is a need for a global ecological civilization with roots in the diversity of global cultures and their history of relationships with nature: There are scientific roots within Enlightenment, already layed out by Alexander von Humboldt [8] or by the GAIA-hypothesis [9]. But there are also problematic religious roots of the program of exploitation of nature as they can be found in context of the roman-catholic church [10]. However, recently Pope Francis formulated an impressive vision of a humanistic integral ecology [11]:

"We are faced not with two separate crises, one environmental and the other social, but rather with one complex crisis which is both social and environmental. Strategies for a solution demand an integrated approach to combating poverty, restoring dignity to the excluded, and at the same time protecting nature."

And also of the development of an "ecological civilization" as it is proposed by Chinese scientists and politics claims for similar attempts [12]:

"Ecological civilization is an eco-innovation, rooted in the traditional wisdom of Unity of Nature and Humanity, to harmonize the apparent contradiction between economic development and environmental protection, including biodiversity conservation."

Although these initiatives are very impressive and hit the point of our current civilizational crises, the practical policies seem to be hindered. Obviously an ecological turn of developed countries is in a severe conflict with global economic interests (e.g., international oil and gas companies) so that necessary change processes are prevented, although in context of ecological economy the contradictions between ecology and economy are analyzed on a wider time scale showing economic benefits by ecological turns [13,14].

In order to enforce this goal of ecologization of human civilization [15], a realistic set of sub-goals that encompass all sections of societies such as politics, law, economy, and amongst all—health care and health science on all levels—global , national, regional and local—have to be operationalized as it was figured out by SDGs [16].

In order to harmonize these partially conflicting goals, a first key issue is raised here, namely a challenge for *knowledge integration* between ecology, economy and social science. In addition, we think that a necessary transition to a truly ecological age should be underpinned by a structured systemic orientation framework that distinguishes whole-society megatrends on the macro-level, regimes on the institutional meso-level and changes at the microlevel by actors as change agents [17].

However, is this the whole story? Is the drive to develop technologies also an essential component of human endeavor? We briefly look at this issue.

2. Anthropological Roots of Industrialization/"Homo Deficiens"—Anthropological Routs of Industrialization?

The development of new technologies could have some anthropological roots, as already described by the ancient Greeks in the Prometheus myth [18]: Humans had a high vulnerability at their creation—compared to animals—and therefore Prometheus gave them fire, which he stole from the Olympian gods and which should enable humans to develop technology, knowledge and more generally civilization. This myth has counterparts in anthropology and sociology of technology of the influential Arnold Gehlen, who related his sociological theories of institutions on the image of men as a "deficient being" [19]: The intrinsic need to invent technologies is enforced by the external institutionalized cultural program to increase effectiveness and efficiency. In our view, this micro-perspective of anthropology—as an integral science of humans—can complement the usual sociological macro-perspective that supposes that on the institutional level economy is driven by disparities. This anthropological perspective that explicitly uses a multidimensional view of humans is a core issue of human ecology as it will be described later [20].

3. Ecological Perspectives in Medicine and Health Sciences

As already mentioned in the context of the SDGs, health is one of the ultimate goals in human life (SDG #3; [21,22]). And it is now increasingly recognized that environmental changes also have a negative impact on human health [23]. Therefore, we focus on the view of an ecologization of health within the scope of (health) science/medicine

as it is already well known that several health risks and damages are caused by the industrialized world, such as air pollution, general contamination of various environmental media by synthetic chemicals such as pesticides etc., micro-plastics in the sea and even in the human bodies etc. It even has to be minded that the foundations for modern Western medicine were already laid in ancient Greek medicine by Hippocrates and his students: it was recognized that the state of the environment has an influence on human health. In particular, the health effects of weather and climate were taken into account, similar to what is done today in the field of 'climate medicine'. This old and new field of medicine is currently a response to the climate catastrophe with global warming and its health consequences.

3.1. Environmental Medicine

This traditional view of environmental health continued partly in the field of practical naturopathy. At the university level, only weak initiatives to establish an environment-related integrative view into medical schools can be seen. It was not until the 1970s and 1980s that 'Environmental medicine' became a special field in academic medicine [24]. This field was primarily concerned with the health effects of industrial chemicals and radiation in all environmental media in relation to allergies, cancer and cardiovascular diseases. These fields of research were the subject of medical sub-disciplines like toxicology, epidemiology, hygiene, occupational medicine, etc. It was mainly a discipline-centered general view of health and environment and lacked a lifeworld-related perspective because of its single-factor view on toxicity of cadmium, mercury, lead, etc. In addition, increasingly the medical view on disease was extended to 'health' and thus '(environmental) health science' emerged which employs comprehensively studies with focus on health by biological, physical, and social sciences [25,26]. As this broad approach, similar to medicine, also lacks solid knowledge integration, several attempts have to be made to construct an integrated picture of environmental health which might be framed by (human) ecology, as we suggest later.

This university-related development in the field of environment and health subsided around the year 2000. In recent years, however, several globally oriented influential initiatives emerged. In early 2023, after the end of the Coronavirus disease (COVID-19) pandemic, the increasing threat of climate change gradually captured the public consciousness and everybody might remember extreme weathers in that year. These weather events made it clearer that we urgently need to develop perspectives on climate medicine and other issues of environmental health that focus on interactions of nature and society in relation to human health.

Recently, in the summer of 2023, the German Advisory Council on the Environment published a new integrative view on environment and health with the recommendation "Consistently thinking environment and health together" [27]. It states and even demands the following, among other things:

- *Environmental pollution also has a social dimension*
- *Currently relevant health-related environmental impacts are particulate matter, antibiotic resistance, environmental chemicals, heat*
- *Nature as a health-relevant resource*
- *"Ecosalute" policy is needed*
- *Sustainable management of environmental pollutants is necessary*
- *Urban health can be improved*
- *Expansion of cross-sectional political work*

Finally, in October 2023, 200 leading scientific journals called on the WHO to declare a health emergency due to the climate emergency [28].

4. Some Holistic 'Mundial' Efforts for Environmental Health

The globality of environmental burden has facilitated worldwide oriented and acting health approaches, so to say 'mundial' approaches ('mundial' comes from Latin mundus): As with the SDGs, which also define health as an important goal for sustainable development, increasingly, since about five or ten years, a strong popularized thematization of climate effects on health emerged and cumulated in everyday-relevant 'climate medicine' [29,30]. In addition, already some initiatives emerged with such large-scale goals as 'One Health', 'Eco Health' and finally 'Planetary Health'. These initiatives offer a pragmatic action-oriented view point regards global environmental health issues.

We briefly characterize some of these globally oriented health initiatives here:

- "*One Health*" is an integrated, unifying approach to balance and optimize the health of humans, animals and the environment [31,32]. From this perspective, it is particularly important to prevent, predict, detect and respond to

global health threats such as the COVID-19 pandemic. Historically, one health has initially dealt with health threats at the human-animal ecosystem interface, such as antibiotic resistance in microbes, which are evoked by application of antibiotics to livestock for prophylaxis and treatment of infectious diseases, but also for fattening. This development of resistance can lead to severe disasters in hospital treatment, with the consequence that infectious diseases in humans can be incurable.

Critically can be remarked that this view point focusses more and more to the infectious diseases and neglects the other environmental impacts (e.g. social conditions) on human health [33].

- The *EcoHealth Alliance:* this approach develops science-based solutions to prevent pandemics and promote conservation [34]. An important focus is the study and management of ecosystem functions such as clean water.

Critical is the anthropocentric instrumental view on nature regards the ecosystem service delivery. Also the emphasis on technological interventions such as vaccinations to prevent infections is reasonable but it seems increasingly that techno-fixes dominate this view point and somewhat neglect the intrinsic bio-logics of ecosystems.

- *Planetary health*: it deals with the Anthropocene and planetary boundaries, climate medicine, urbanization, food systems, biodiversity shifts and natural disasters [35].

Critically should be discussed the lack of an integrative conceptual framework that allows for a balanced relational intervention as it will be figured out later. Also the lack of the socio-cultural level can be criticized.

- *Global health:* It is concerned with the world in which health and well-being for all can be ensured through equitable, inclusive and sustainable investments, policies and services [36].

Criticism addresses the deficiencies of a theoretical foundation by social science compared to biomedical approaches although its focus is the social environment on a global scale, especially regards the access to health care [37].

Taking these issues together, it becomes obvious that an urgent need to relate health troubles of humans to the global animated and unanimated natural environment and to extend this view regards the whole world society. It emerges that all this above mentioned overlapping but disconnected approaches are very concerned with a loss of balance between men and natural environment [38]. However, this comprehensive view did not combine these various environmental conditions that disturb and also strengthen human health, but this is exactly the subject of a systemic human/social ecology as an academic discipline. At least there is a lack of integrative conceptual efforts that cover the heterogeneous multi-factorial origins of health and diseases. For this reason, we highlight here the scientific foundations of an *integrated environmental health perspective.*

5. The New Framework—An Outline of a 'Systemic Human Ecological Medicine'

In the 1970s, the field of an interdisciplinary Human/Social Ecology emerged that combined various individual disciplines (e.g., medicine, sociology, psychology; [39,40]). This type of a worldwide operating and multidisciplinary based "integrative Human ecology" started around 1975 in Vienna and led to the foundation of the International Society of Human Ecology [41] and its German equivalent [42]. At that time, the comprehensive (theoretical) framing of studies of the relationship between and men and (natural, technical and social) environment was the object of epistemic interest.

Human/Social ecology has developed to a remarkable extent through research in other fields such as agriculture (Agroecology), nutrition (Nutrition ecology) or city planning (Urban ecology) and has also been able to establish some educational programs at high school level [43]. At that time in Germany, medical scientists and physicians working on the topic of habitat and health, e.g., Paul H, Putscher M, Schaefer H, Roggendorf K, Aurand K and others constituted the vison of an ecological medicine [44]. At present, there is only poor elaboration of health issues in context of human ecology. But due to COVID-19 pandemic we published a position paper on pandemic research in summer 2023, which—as mentioned—can serve as a call for ecologization of medicine and health science [45]. This corresponds to ecological perspectives already formulated in medical specialties: Theoretically, some singular but established initiatives are already providing impulses in this direction, such as the team of Lawrence Kirmayer in psychiatry [46], Anthony J. McMichael [47] and Nancy Krieger [48,49] in epidemiology and public health or the famous 30 years successfully applied "Rainbow model" for conceptual framing of public health issues [50]. However, these approaches also suffer a little from a balance between explicit systemic conceptualizations on the one side and a systematized construction of the concept of environment on the other side.

In line with these approaches and our theoretical criticism we focus here on the four most important key points for the foundation of a "systemic human ecological health science" as we see it from an human ecological basis (see Figure 1):

5.1. The Focus Should be Individual Humans

Medicine in practice always has to do with "situated" individuals, especially in family medicine, community medicine and public health issues. This view of a "personalized medicine" must be explicitly re-established after the dominance of pandemic research and management: the terms "population"/"public" have often been used as a category as if humans were a collection of isolated objects in a box. This is based on very reductive, positivistic and materialistic images of humans coming from molecular biology, virology and data analysis. Although pandemic management is aimed at 'the' population level, a correspondingly pluralistic concept is one that is based on the individuality of people and understands them as consciously experiencing beings and goal-oriented but also spontaneously behaving actors who make decisions as autonomously as possible in an individual life situation, but who also interact with each other—they are "situated individual subjects in shared and differing environments", especially when it comes to patients and their relatives in context of health care!

In order to understand people as systemically connected bio-psycho-socio-ecological beings, as it was figured out already by George Engel [51] a multi-layered anthropological integration of knowledge across different disciplines is required [52,53]: the human should to be understood more in terms of its intercultural identities and differences, as mentioned here at the beginning, regarding the personalized level of drivers of industrialization.

5.2. Human Ecology as a Conceptual Framework

If humans are conceptually at the center of health-related efforts, the notion of environment can be constructed concentrically and multi-modally and can be overarched through a systemic multi-level framework (macro-, meso-, micro-level) of interacting factors to which the humans have numerous relations. The multi-level human-environment interactions are supposed to be considered in four main dimensions: the humans that surround the individual (e.g. family), the proximate and distal natural environment, the surrounding techno-system and the social system, each of these systems distinguishable regards their proximity to the individual (micro-, meso-, macro-environment). This integrative but differentiated view is fundamental to all variants of human/social ecology: Human-environment relationships put humans in the center but frame them within the natural and the socio-cultural environment. In terms of health, the total environment shapes the risk of and protection from diseases and their course on the individual and collective level. Society, technology and nature are essential and systemically interconnected environmental subsystems, in addition also human-human relationships are relevant, especially regards communicable diseases [54].

For instance, pandemics must be viewed from a human ecological framework as they are often triggered by zoonoses: they are primarily the result of problematic human-nature interactions. Therefore, for analysis and prevention, the conceptual framework of "societal relations with nature" as the epistemic object is described in "social ecology" of the Frankfurt school [55], the Vienna school [56] and also the framework of "human ecology" as a systemic sustainability science [57] should be used.

There are already some "socio-/social ecological approaches" in context of public health as it was mentioned above. These approaches should be elaborated theoretically, with their conceptual models, as they offer medicine and the health sciences a framework for an integrative theory not only of the pandemic, but also for a comprehensive understanding of health and disease in respect to non-communicable diseases in epidemiology, diagnosis, treatment and prevention [58,59].

5.3. Knowledge Integration by Transdisciplinarity

The global multi-level and multi-sectoral perspective described above endorses a huge set of heterogeneous qualitative and quantitative observations and concepts that is necessary for a comprehensive description of heterogeneous complex ecosystems. However, if such a heterogeneous data collection is realized, the epistemological problem arises that data gathered by natural sciences must be matched with data from social sciences, which means that a categorical difference with ontological depth must be bridged. In addition, in context of societal problems not only results from academic sciences but also from non-academic social actors as problem stakeholders have to be considered. Both sources of evidence may result, after intensive co-working endeavors, in new explanations and maybe also in more practically relevant implementations [60].

However, integrating this multi-faceted picture is a challenge that needs qualified epistemological, methodological, theoretical and multi-professional efforts for research and management. This epistemic challenge is handled in environmental sciences as the mentioned methodology of "transdisciplinarity" [61–63]. These epistemic principles and procedures should be also a guideline for health-related knowledge integration, as there are many islands of knowledge which need to be combined with the knowledge in health sciences and medicine, such as the view point of citizens,

patients and relatives, and medicare practitioners. In contrast, current trends in (health) science can be seen as data-driven and as being based on computational science. This implies that a transdisciplinary production of health-related evidence must urgently be established by inclusion of the patient/citizen perspective into interdisciplinary perspectives of the various health sciences.

5.4. Qualified Systemic Thinking is Necessary

The sophisticated explication of the individual interdependencies and their function-analytical assessment as a whole is needed. This requires an elaborated systemic viewpoint (e.g., referring to Systems dynamics [64]). In complex dynamic impact structures such as pandemics, the methodology and holistic perspective of systems science are a prerequisite for good scientific practice [65,66]. The systems approach as an explicit methodology of modeling can be used to construct integrated multi-level/multi-layer and multi-area models as it was demonstrated by the widely known "world models" [67]. Population health is thus understood as the state of a multi-layered, self-organizing, dynamic macro-system consisting of groups of individuals acting and interacting intentionally with themselves and with specific environments. Such interdisciplinary models go beyond the typical epidemiological person flow models of the type of SIR models (S: susceptible, I: infected, R: recovered; [68]).

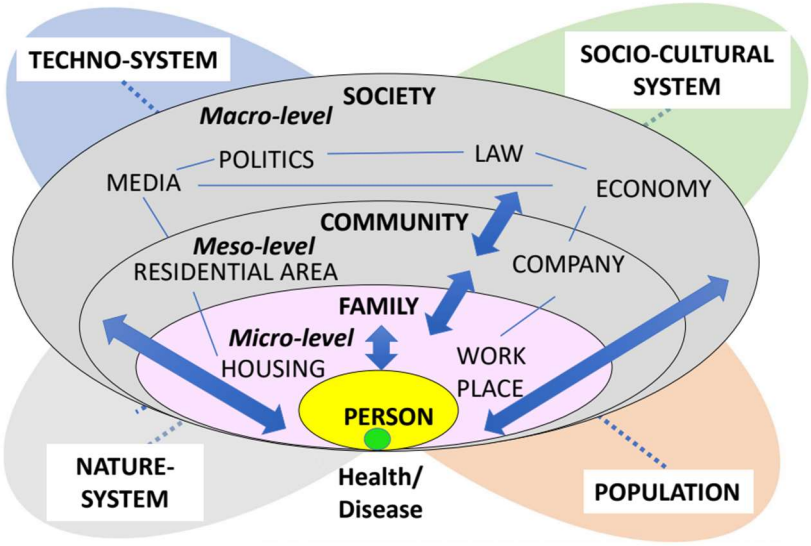

Figure 1. Visualization of an integrative systemic human ecological framework for health science/medicine (adapted with permission from [69]).

Taking all four of these criteria together, this would be one important field of "ecologization" of the medical culture. With this program in mind, it could also be possible to improve the connection to current environmental science.

In order to illustrate the advantages of a human ecological perspective we give two health-related examples:

- Social ecology (or: human ecology) of *cities* ("urban ecology"): Cities as human ecosystems are structures that are composed of interdependent and self-organizing natural, technical, human and social subsystems that can determine health. By use of the systemic human ecological lens not only a contextualized analysis of focal urban health problems but also an integrated and consistent problem solution could be realized [70–72].
- Human ecology (or: social ecology) of *nutrition* (nutrition ecology): the nutrition system network—centered around the supply and demand systems—has natural, technical, human and social components that exhibit overlapping interactions (e.g., via the microbiome) and finally determine the health status of the individual and the population [73–75].

Further health-related projects in these and other societal fields could elaborate advantages for research and implementation by perspectives of human ecology.

6. Conclusions

With regard to the utility of explicitly integrating health issues into the process of ecologization of civilization, several intellectual efforts have to be made as they were mentioned above. We believe that several goals need to be

addressed in order to develop a scientific approach which (1) deals with the humans as the focus, (2) frames this view by human ecology, (3) realizes knowledge integration, and finally (4) applies a sophisticated way of systems thinking. Through this qualified picture of health and environment, the sites of this research can serve as a robust concept for the practice and design of differentiated but integrated health science and care. This would help to be better prepared for future health challenges.

Author Contributions

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used Conceptualization, F.T.; Methodology, F.T. and K.-H.S.; Resources, F.T. and K.-H.S.; Writing—Original Draft Preparation, F.T. Writing—Review F.T. and K.-H.S.; Review Editing, F.T.; Visualization, F.T.; Supervision, K.-H.S.

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