The boundaries of scientific knowledge

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Summary

The scientific age is characterised by a framework of thinking which is based upon Aristotelian logic combined with the axioms of experimentation and causality. Experimentation as expounded by Galileo demands reproducibility, quantification and limitation to simplified systems; this "analysis" of the world in which we live by models which are accessible to mathematical description is one of the most fundamental prerequisites of science. The six requirements of this framework of thinking are therefore:

- reproducibility
- quantification
- analysis
- clarity
- freedom from contradiction
- causal justification

This framework of thinking has proved so successful that it not only had to be adopted by other cultures but is accepted by us as the only "true" form of thinking; it is a characteristic of the "scientific age". Yet over 80 years ago quantum physics recognised that this framework of thinking is not at all adequate for describing matter. Its use in technology however meant that success could be achieved by following instructions (checklist) as if for a recipe where personal emotional commitment is not only not necessary but is often even disruptive. Consequently this framework of thinking became the basis for Western modernity.

Overcoming the boundaries of this framework of thinking may not mean seeking an alternative but admitting that other forms of thinking are also officially recognised. This is particularly important where man and his immediate needs are at stake because the dignity of man (according to Kant) rests precisely in his uniqueness, which does not fit into this framework of thinking.

In Aristotelian either/or logic everything is either science or opinion. Plato speaks of "understanding" which is certainly darker than science but more than opinion. In addition contradictions must also be considered if they are needed to understand the issue.

In medicine an example of a "dialectic" contradiction such as this is the requirement to be receptive and yet at the same time critical. In Aristotelian either/or logic, "critical" becomes "narrow-minded" and "receptive" "credulous". Both should be rejected equally; one should aim for synthesis although this cannot be achieved without conflict.

The origin of systematic thought

To understand the meaning of scientific thought and action, we have to go back to the beginning of systematic thought. Plato[1] has Socrates ask:

"Should we say that the blind power of the unreasonable and pure chance reigns over the universe of things and the world as a whole or, in contrast, that reason and an admirable realisation organise and direct them?"

Nowadays this ancient question could perhaps be rephrased: "Are we placed blindly at the mercy of the laws of nature or can we help shape them?"

In the widest sense this also means: "Are we at the mercy of our physical constitution or can we shape ourselves?" I should like to warn you against answering this question rashly one way or the other.

In the search for the essence of the world Parmenides and Heraclitus had already adopted opposing viewpoints before Socrates proposed his theory: Heraclitus viewed "becoming" as the actual essence of the world. Since however change can only be observed if at the same time something remains the same (something changes, the same is now different!), Parmenides regarded change as pure appearance and saw the essence of the world in unchanging being. Socrates and his pupil Plato were the first to try to unite these two viewpoints (dialectically) to a bipolar world view. However, through the significant work of Plato's pupil, Aristotle, this magnificent attempt was later pushed back into the shadows again.

Aristotelian logic

Aristotle criticised Plato because he did not bother about physics or describing nature:[2] *"And since Socrates was now dealing with ethical objects and not with all of nature, but in it searched for the general and first directed his thoughts to definitions, this brought Plato, who adopted his views, to the assumption that the definition has something of the sensual of various things as its object; for it would be impossible to have a general definition of any sensual object as these are constantly changing."*

Aristotle is regarded as the founder of Western science. His axioms of logic, in particular, have shaped our thinking. Aristotle is content with three axioms and this is perhaps one of the reasons for the success and effectiveness of Western thinking.

The axioms of logic (according to Aristotle):

1. Principle of identity:
   Requires concepts to be unambiguous.
2. Principle of contradiction:
   Requires statements to be free of contradiction.
3. Principle of the excluded middle:
   One side is right in the case of outright contradiction.

The principle of contradiction can also be formulated as follows: *"At least one of two contradictory statements is wrong!"* They may both be wrong however! Consequently, the effect of the contradiction in the 3rd axiom is reinforced! In the case of outright contradiction arising through negation *one of the statements must be right!*

Unlike other cultures the West always stakes everything on one chance. It does not strive for many different forms of thinking, instead the most suitable form at the time should be universal. As a result, Plato's dialectics have almost completely disappeared from official thinking and official organisation of human social existence. I should like to stress that we don't suffer due to the shortcomings of Aristotelian thinking, instead we suffer because it is so unbelievably effective and successful! For, due to this success, we still believe today

[1] Plato: Philebus 28C1-29A8.
[2] Metaphysics 987b.

that all other forms of thinking should be replaced by Aristotelian thinking and this is one of the reasons why holistic medicine now has difficulty being officially recognised.

Modern age

We set the end of the Middle Ages and the start of the modern age as 1492, the year of Columbus' discovery of America. What makes the discovery of America so important that it marks the beginning of a new era? It was a completely new approach to the question of truth.

Anyone doubting the valid truth in scholarly discussions ran the risk of being burnt at the stake (just like Giordano Bruno in 1600). Columbus didn't answer the question "Is the earth round or flat?" by scholarly discussion but by action! And this is the characteristic of the new age, that the concept of truth is created by combining thought and action.

This is also the basic idea of science which was accomplished around one and a half centuries later. For the essence of science lies in the interplay between theory and experimentation and this corresponds to the combination of thought and action. The experiment is a certain type of action, a deed. It is experimentation and not a theoretical consideration that determines which statement can claim general validity.

Science's new method does not achieve "truth" but something completely new. In the 16th century truth, which had remained untouched up to the end of the Middle Ages, began to falter in two regards: on the one hand through the wars of religion where religious truth was at stake and, on the other, through the fact that the calendar "had got out of control" so that the eternal validity of the Aristotelian world view had to be reconsidered. To this end the guardian of truth, the Church of Rome, made a fundamental decision: it distinguished between **truth** and **hypothesis**. Truth applied only to that which related to the whole, while in the now complex world in order to overcome concrete problems it was to be permitted to create hypotheses for parts of the whole which should be judged simply by their expediency and which should not make any claim to truth.

The Church initially had no problem with the Copernican world view of which it merely demanded that it was presented as a hypothesis. It helped draw up the new calendar which was finally introduced in 1582 by Pope Gregory XIII.

Science

We trace the beginning of scientific method back to Galileo Galilei. He picked up the Church's distinction between truth and hypothesis, yet left truth untouched[3]: *"I am inclined to believe the authority of the Holy Scriptures is intended to convince people of those truths which are necessary for their salvation …"*

But he claimed that hypotheses were not entirely random and were only to be evaluated on their usefulness; Galileo spoke of the "nuova scienza" with which he could examine hypotheses to determine the extent to which their predictions were correct. These predictions do not relate to the world which we can describe as world of experience but to the *experiment*. Today we describe "nuova scienza" as science and the experiment must be defined by concrete requirements to allow it to strive for universal validity. I describe these requirements as axioms of experimentation (by analogy to logic) and summarise them here:

The "axioms" of experimentation

1. Reproducibility
   Test results must be "inter-subjective", i. e. independent of the experimenter!

[3] Galileo Galilei: letter to Castelli dated 21 Dec. 1613. (A. Favaro: Le Opere di Galileo Galilei. Ed. Nazionale (1890-1909) V, p. 281).

2. Quantification
   Science attributes quantities to all qualities!
   "Measure everything which can be measured."
3. Analysis
   The method can only be applied to "simple" (simplified!) systems!

The requirements appear understandable and straightforward, however the requirement for reproducibility, for example, is not at all trivial in the practice of scientific research. (I have discussed this problem in detail in one of my textbooks on scientific theory[4].)

Under *Analysis* I understand the restriction to simple systems. Here's an example: unlike those of Aristotle, Galileo Galilei's laws of falling bodies are not valid in the world of experience but in an imaginary world without aerodynamic resistance. In this sense the laws of science are always approximations of the world which is much too complex to be recorded legitimately and in this sense science is always analytical, i. e. related to parts or subsystems and can therefore conflict with a synthetic or holistic intellectual approach.

Scientific results relate exclusively to matter in space and time. The mind (including all questions of meaning, wishes, hopes, etc.) must be ignored.

As Carl Friedrich von Weizsäcker said[5]:

"Philosophy asks those questions which because not asked by science have contributed to its success."

[4] Herbert Pietschmann: Phänomenologie der Naturwissenschaft [Phenomenology of science]. Springer Verlag, Berlin (1996). 2nd edition Eur. Univ. Press Vienna (2007), chap. 5.

[5] Carl Friedrich von Weizsäcker: Deutlichkeit [Clarity]. Hanser Verlag, Munich (1978), p. 167.

The framework of thinking in the modern age

Aristotle introduced a (fourfold) causality to obtain a description of change (and movement) which was free from contradiction.[6] *"It is clear from this that wisdom is a science with definite causes and principles."*

The four forms of causality should always contribute together to all events even if to a different degree.

The four forms of causality according to Aristotle

Final cause	causa finalis
Formal cause	causa formalis
Material cause	causa materialis
Efficient cause	causa efficiens

Since scientific results relate only to matter in space and time, we can eliminate the final cause which may contradict the efficient cause. We require scientific results to be based solely on cause-effect relationships, so *causality* (in contrast to finality). So we have developed the six requirements (I have combined the two contradictory axioms of Aristotelian logic into one) of the Western framework of thinking in the modern age:

The Western framework of thinking since the 17th century

Reproducibility Quantification Analysis	*Action*
Clarity Freedom from contradiction Causal rationale	*Thought*

Through scientific method, the interplay between theory and experiment, we obtain statements which display a completely new quality. I call this quality "*certain*" in the sense of *reliable*. *The content* of scientific

[6] Metaphysics 982a.

statements is not certain, not correct and not true! They can be replaced in a so-called paradigm shift by better and sometimes completely different statements.

Responsibility and duty of care

The absolute reliability of producing the result of chains of action is an achievement in the history of mankind which may seem obvious to us today but which three hundred years ago scarcely anyone on earth and around one hundred years ago scarcely anyone outside our cultural circle could dream possible. This achievement is so fundamental for the whole of mankind that we must obviously aim to extend it from science to encompass all areas of human social existence. This is welcome and pleasing due to the positive effects for mankind! What can be criticised here, however, what we appear to have forgotten on account of this positive effect, is that this method can reasonably only be applied to matter in space and time, that man cannot be reduced to his body alone, if he is not to lose his grip on the meaning of his existence and sometimes also health.

If the result of a chain of action occurs with certainty, if each individual link in this chain has been performed correctly, then there is no *responsibility* for this type of action but probably a *duty of care*. I understand "duty of care" to be that ethical attitude which takes care to perform a link in a chain of action only if the person acting is convinced they are doing the correct thing.

On the other hand, I understand "responsibility" to be that ethical attitude which is only sought when it is a matter of decisions whose consequences cannot be estimated with certainty (or often not at all). Responsibility then means deciding freely on one of the options and accepting the consequences whatever they may be. This attitude is not required in the technical field but certainly necessary in the interpersonal realm.

Before I examine this distinction more closely, I should however like to consider the framework of thinking of the modern age once more and compare the individual requirements with that which they exclude.

Framework of thinking

Included:	**Excluded:**
reproducible	one-off
quantities	qualities
analysis	survey, synthesis, interlinking
clear	receptive, "colourful"
free from contradiction	living, conflicts
causally based	wishing, creativity

What is excluded from our framework of thinking eludes officially recognised, generally applied methods. In the private sphere and also in the area of human communication, we obviously cannot manage without this part. I want to compare these two areas – inclusion and exclusion or technomorph and social consideration – once more in another form:

Duty of care	**Responsibility**
Laws of nature	Formulation of demands and objectives
Order	Decision
Experts	Decision-makers
Predicting	Proving worth
Knowledge	Conscience
Science	Ethics
Learning	Practising
Heteronomy	Self-determination
Heteronomy	**Autonomy**

Yet the following is true:

Free decision in the area of duty of care is stupid!

Delegating the decision in the area of responsibility is cowardly!

But there are no sharply drawn boundaries between the two spheres. Consequently the path of the mature individual is a balancing act between stupidity and cowardice! It is no disgrace to sometimes fall from this tightrope, whether into stupidity or cowardice; but we must continually strive to climb back up onto the tightrope again. If we do not do this then we exclude ourselves from the community of mature individuals.

The concept of disease in the scientific framework of thinking

If scientific method is assumed to be the basis of medicine without regarding its boundaries, this leads to the following consequence: in the technomorph approach, man is regarded as similar to a machine, disease is comparable to a *breakdown* and must be *repaired*. Wherever the technomorph view of man is reasonable, i. e. where it is a matter of spatial-temporal disruptions of the body (matter), the application of scientific method not only makes sense, it is the best thing we have today and probably will ever have in future. Typical examples of this are physical injuries following accidents.

How can we define disease in the scientific framework of thinking?

If all the possible readings for our body lie within the normal range then objectively we are healthy. Anyone who feels (qualitatively) ill however is then, depending on your view, a hypochondriac, mentally or psychosomatically ill.

My aim is not to denigrate the concept of disease just described. I just want to show quite clearly that the question of health cannot be discussed without the underlying framework of thinking.

Other frameworks of thinking

Alternative frameworks of thinking have been suppressed in our culture by the triumphant progress of modern science and technology based on Aristotelian logic. They may well have been continually presented in philosophy from Heraclitus via Plato to Hegel, however they were unable to gain acceptance in practice.

Johann Wolfgang von Goethe polemicised against Newton's thinking in his theory of colours and countered him with "polar thinking" which he believed more fitting for the human sphere.

How could disease be defined in polarity's framework of thinking? In his *Einführung in die Polaritätstheorie* Otto Köhne writes[7]:

"Unlike the determined defender of conventional medicine, the founder of a polar theory of disease should lean towards the attitude of dedication to what is real. To the extent that such an attitude is expressed scientifically in today's general medicine, expression is found not in the principles of conventional medicine but in certain scientific principles of naturopathy."

For the polar thinker, disease is not a deviation from the norm but a disruption of the state of balance. A method of healing which can quite rightly refer to this framework of thinking is acupuncture.

The medical historian Heinrich Schipperges[8] points out that, around 1800, a similar concept of health was still gaining recognition. Novallis built a building for teaching polar medicine which also influenced philosophy.

Disease is not therefore a deviation from the norm, "disease is a dispute between the organs." Health is the balance between polar opposites and all disease has to serve this balance. So disease is not just viewed negatively as something to be eradicated; in the context of polarity it also has meaning

[7] Otto Köhne: Einführung in die Polaritäts-theorie [Introduction to Polarity Theory], Mannheim (1981).

[8] Heinrich Schipperges: "Grundzüge einer polarischen Medizin bei Novalis" [Novallis' principles of polar medicine]. In: M. Eliade and E. Jünger (eds.): Antaios, Stuttgart (1966).

which can be grasped as the opposite of health.

Friedrich Weinreb calls one of his books "Vom Sinn des Erkrankens"[9] and writes in it:

"Man can be scientifically explained and defined, measured and treated and yet at the same time he eludes the scientific in an acausal realm where nothing can be defined or measured, where he cannot be treated but possibly loved or trusted, where only longing and devotion count. And man is both of these, not one or the other."

And so we have reached the crucial question: if there are two different concepts of disease (according to the different frameworks of thinking of logic and polarity) which are not compatible without contradiction, which should we officially recognise?

However, before we address this question, I should like to mention a third framework of thinking, that of dialectics. While Aristotelian logic regards contradiction as a fault and eliminates it, in the dialectic framework of thinking it can be seen as an aporia and a source of development and thus take into account the living aspect of man. Obviously it cannot make sense to regard every contradiction as a source of development for errors and faults, which it is essential to eliminate, actually do exist. There is an element of personal responsibility in distinguishing between faults and aporiae which we only encounter in the dialectic framework of thinking.

In the dialectic framework of thinking man is not either sick or healthy. The living person at the height of his powers is always in the process of regaining his health. He *is* not healthy, he makes himself healthy by his own efforts and only he is capable of doing this. So the sick person suffers under a contradiction which I shall present in two sentences:

Thesis: Man can only regain his health by his own efforts.

Antithesis: Man cannot regain his health without help for he is sick.

This contradiction can be brought to a synthesis if we realise that of course nobody can make the sick person healthy but that he must be helped to help himself.

A physician who takes this idea of health as his starting point will not always act differently from a conventional medical practitioner. But he will be more receptive and will, for example, also seek remedies which are not necessarily explicable in the sense of a cause-effect relationship. Anyone who wants to help a sick person to help themselves should not ignore the final cause for he has a goal in mind.

Kant[10] speaks of the need always to understand oneself as a person (as a reasonable being) from both spheres: absolute necessity and freedom or heteronomy and autonomy. Kant also claims that, in the human sphere, everything has either a *price* or *dignity*. Whatever is replaceable (which lies within the framework of thinking) has a price, what is not replaceable by virtue of its essential uniqueness has dignity. Obviously the individual, man belongs to this latter category. In this context we can claim that healthcare and medicine must necessarily serve the achievements associated with the framework of thinking of the modern age but that they must not be reduced to this because they would harm the dignity of the individual.

In this content, the WHO (World Health Organisation) in its statutes defines health as follows: *"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."* And it goes on: *"The enjoyment*

[9] Friedrich Weinreb: Vom Sinn des Erkrankens [From the meaning of disease], Bern (1979).

[10] Immanuel Kant: Grundlegung zur Metaphysik der Sitten [Fundamental principles of the metaphysics of morals].

of the highest attainable standard of health is one of the fundamental rights of every human being."

I understand medicine's continuing development as an admission of different forms of thinking and concepts of health which may contradict one another. Rather in the way that the Indologist Heinrich Zimmer characterises Indian thinking[11]:

"Both theories possess the same seriousness but their coexistence does not lead to any conflict. Apparently thanks to the general structure of Indian thinking: ...accepting, for the same object …,various aspects which, each theoretically reasonable in itself, do not develop any claim to sole validity. They are designed not to record and explain the whole of reality but just to name and construct definitions for an individual piece of reality. But it is not felt to be its duty to structure, without contradiction, the whole of reality in its wealth of relationships."

Only if contradictions are permitted in the network of the structure of reality does genuine responsibility exist. Taking the example of medicine, this means that, within an integrated framework of thinking, the doctor probably has a duty of care but no responsibility for the choice of concept of disease (i. e. conventional or alternative medicine).

Genuine responsibility exists only where a choice must be made between various alternatives without the consequences being clear, predictable and free from contradiction.[12]

What is required in that kind of situation is an attempt to synthesise unity and diversity. Socrates and Plato have already shown how this can take place, namely through dialectics. In order to make this frequently misunderstood concept more manageable, I have devised a simple scheme[13] which I should now like to present in the final part of my paper.

The H scheme

I want to explain my scheme for overcoming dialectic problems by means of a relevant example which is particularly clear. No-one will dispute that the correct attitude on the part of the scientist towards anything new should be both "critical" and "receptive"! Critical so as not to fall victim to any deception, desires or even fraud; receptive so as not to overlook important new discoveries.

critical **+** ***receptive***

However, the two attitudes cannot easily be united in a "not only but also" relationship as they may contradict one another.

critical **↔** ***receptive***

This is precisely the characteristic of a dialectic problem. It is essential to achieve a union *despite* the contradiction! And here the following process always begins which it is important to work through.

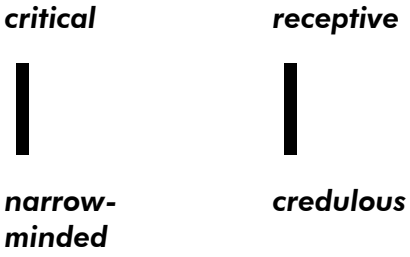
At first various groups will identify with one or other of the two sides. In any dialectic problem it should be established that the two concepts advocated cannot be simply defined in terms of logic because otherwise one side would be right and the other wrong. Each of the two concepts has, to a certain extent, a *shadow* which runs into it without any boundary. We can indicate this

[11] Heinrich Zimmer: Spiel um den Elefanten [Play around elephants], Düsseldorf (1976).

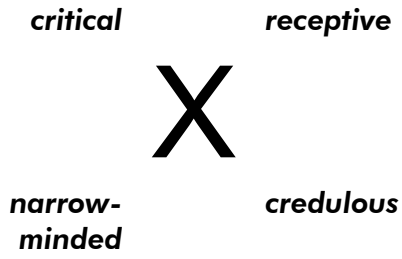
[12] H. Pietschmann: "Naturwissenschaftliche Methode und Medizin [Scientific method and medicine]". In: Lehrbuch der Naturheilverfahren [Naturopathy manual], vol. II (eds. K. C. Schimmel), Stuttgart (1987). See also: H. Pietschmann: Philosophische Grundlagen einer Ganzheitsmedizin [Philosophical bases of holistic medicine]. In: Ganzheitsmedizin in der Zukunft [Holisitc medicine in future], (eds. A. Stacher and W. Marktl), Facultas-Universitätsverlag Wien (2001), p. 9-20.

[13] Herbert Pietschmann: Eris&Eirene – Anleitung zum Umgang mit Widersprüchen und Konflikten [Guide to dealing with contradictions and conflicts], Ibera Verlag, Vienna (2002).

by a vertical bar, at whose lower end stands the "shadow concept":

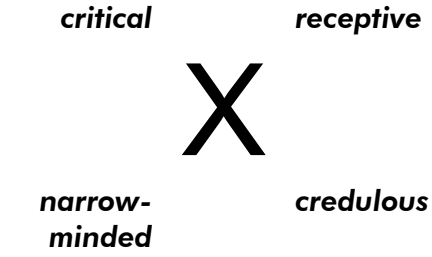


Now there begins a struggle in which each side attacks the *shadow concept* of the other! I call this the state of HX confusion. We can indicate it by a cross which also symbolises dispute:



The critical group fights against credulity and the receptive group against narrow-mindedness – and *both* are right! Consequently this struggle in the HX confusion can last any amount of time! A radicalisation sets in, however, which leads to *both* groups, secure in the awareness that they are right, insisting on their own shadow concept! Anyone who fights credulity long enough will soon slide into narrow-mindedness and anyone who fights against narrow-mindedness for long enough will soon sink into credulity!

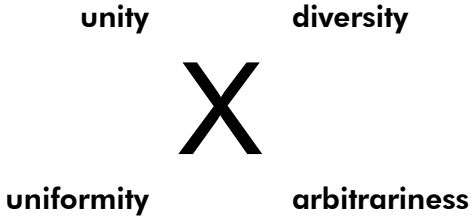
Consequently *both* sides need to realise that, when fighting the opponent, they are also fighting themselves and that the actual opponents are not on the other side but in *their own* shadow concept! Only then can new common ground, a synthesis, be reached in which both sides are linked by a vertical bar: this is intended to indicate that the threat from their own side is recognised and so an understanding is possible:



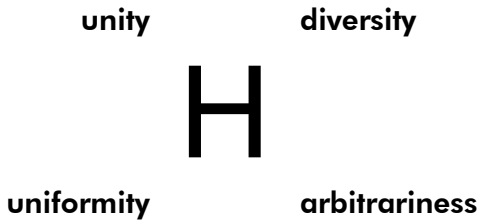
This *appears* very simple but there's a hitch however: this realisation must take place *simultaneously*. If only one side gains this understanding, then the other side wins! Despite this realisation the struggle therefore has to be continued until the other side has also gained this understanding.

An additional example of a dialectic problem is that of unity and diversity.

The aim is to combine unity and diversity in a synthesis. Unity has its shadow, however, namely uniformity and diversity has a shadow, arbitrariness. So, in the state of HX confusion, the struggle is represented as with "critical versus receptive" above:



This struggle – struggle is the originator of all things – is only over when both sides realise that they themselves fall in their own shadow if they fight the other side and that they therefore have to fight against the shadow of their own side! Only if the representatives of unity fear uniformity and the representatives of diversity fear arbitrariness is it possible to reach a synthesis.



But this realisation must happen simultaneously. It is not a matter of one side winning but of a synthesis of both sides!

It is unfortunately a characteristic of all holistic methods that their components cannot be analysed as can the logical and the rational; the two issues described above (critical-receptive and unity-diversity) are inseparably linked which makes examination more difficult but, if synthesis is reached, several rewards can be reaped at once. Diversity of methods without disintegration and critical receptiveness can then both be features of a medicine which encompasses a holistic approach and analytical dissection and which is capable therefore of confronting man in all his richness.