

Logic of Scientific Discovery in ophthalmology

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Summary

Logic is the invisible instrument of stringent thinking.

Research logic is the analytical representation of thought strategies with the aim of achieving progress in knowledge. The latter is achieved either by conventional verification or by the much more meaningful method of falsification (K. Popper). In the present study we compare two approaches: the well-known inductive - and the structural method. With the help of the structural observational method, we have succeeded in refuting the mathematician Listing's hypothesis (cardanic suspension), which was elevated to the status of a law, and in developing a new model of eye movements.

In addition, we discovered the connection between head and eye and the oculo-cervical syndrome as a trigger for complaints that are often mistakenly diagnosed as "dry eye".

The quantification of metamorphopsia in macular degeneration is another result of this study.

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1. formal logic as pure basic research
2. the relationship of ophthalmology to mathematics
3. the relationship of ophthalmology to physics
4. the structural method as reconstruction of a theory of eye movements
5. discussion of methods

Introduction

Logic is mentioned twice in the title of this essay - this is unusual. But it is generally said that logic is the invisible instrument of precise thinking in general. We now try to show that the logic of research is different from the logic of ophthalmology.

1. formal logic as pure basic research

Pure basic research as the logic of research deals with the formal structure of the knowledge of a particular science and its possibilities and limits. We use to call it epistemology.

There is not only one type of formal logic (Bochenski). We now distinguish 10 different forms of logic (Fig.1). For our treatise we will compare two kinds of logic with each other, namely inductive logic (no. 2) and structural logic (no. 8).

This comparison is made without regard to application and particular interest at first.

It is first of all about the stringency in the sense of the consistency of a theory. Then it is about the qualitative progress of knowledge, which is achieved by using alternative strategies, e.g. structuralism as behaviorism. The procedure is observation. A science only attains its autonomy when it has its own logic, own methods and its own procedure. Conventional medicine, including ophthalmology, is an independent science. It has its own logic (the inductive logic), its own method (the experiment) and its own procedure (the transfer of results obtained under artificial laboratory conditions, e.g. from animal experiments to humans).

Inductive logic was discovered by John Stuart Mill in 1843. It is still dominant worldwide. By introduction of inductive logic, the 2000 years old deductive logic of Aristotle was overcome. Structural logic proceeds argumentatively in the sense of Aristotelian topic comparing **problem** thinking with **system** thinking (Viehweg). Its method is the observation of behavior, reactions and processes under **natural** conditions. In doing so, interrelations, interactions and relationships of the functional elements of an organ complex are formulated. This includes teleology. It means that the functional sense of the eye is the orientation in space and time.

The eye is constructed mainly for far vision and not for permanent near vision as computer work, mobile phone, work on machines. In contrast, our working world today requires a high degree of near vision in many fields. To solve this problem, the logic of scientific discovery gives us an intellectual hint.

The inductive method goes from the individual to the general. It formulates statistical laws and significances. Therefore it is a generalizing method and claims for normative validity. .

But since it insists on objective measurement, it ignores the subjectivity and individuality of the patient. The human being becomes a number.

In contrast, the **structural**, behavioristic method is based on observation under natural conditions, argumentation and conviction, taking into account the uniqueness of the human being.

It is known that ophthalmology is an applied natural science. Its methodological basics, however, lie in mathematics and physics, i.e. outside of medicine.

2. the Relationship between Ophthalmology and Mathematics

The eye movements take place as cooperation of the six eye muscles. The six eye muscles have different insertions and different torsional and tractive power. The principle of this cooperation of the six eye muscles could not be described by the measuring method of oculography. Therefore, this question shifted from ophthalmology to non-numerical mathematics, to topology (= the science of positional relationship). In 1850, a colleague of the mathematician Gauss, Johann Baptist Listing, explained the principle of eye movements by the cardanic suspension. (Fig. 2) This abstract **hypothesis** of Listing was made a **law** by the great masters of ophthalmology, such as Helmholtz and Hering. By means of falsification (Karl Popper 1934), we have succeeded in refuting the Listing Law since cyclorotations and translations of the eyes (pro-traction and re-tractions of the bulbe) have been disregarded by Listing. Even great authorities make mistakes. As an alternative, we have introduced the model of the socket-joint to explain all eye movements. (Fig.3)

A second aspect of the relationship between mathematics and ophthalmology is **space**. In ophthalmology, space is regarded as a field of vision serving for orientation. It is divided into right, left, top, bottom, front and back. This spatial structure is Euclidean and therefore measurable, i.e. isotropic and homogeneous. In ophthalmology, however, there are phenomena of non-measurability. This is the case, for example, in wet macular degeneration, a retinal disease that often triggers qualitative visual disturbances such as distorted vision, metamorphopsia. These are not measurable because the spatial structure is inhomogeneous and anisotropic. The affected patient is disoriented. [For diagnosis](#) and for follow-up of the development of the disease, we have modified and quantified the Amsler test the visual field differentiating horizontal and vertical lines (Fig. 4).

3 The Relationship between Ophthalmology and Physics

Classical physics (Newton, Galilei) defended the view that "one must measure everything that can be measured and make measurable what cannot yet be measured". One possible conclusion is that what cannot be measured does not exist. This physical model of pure mechanics is still considered a dogma of conventional ophthalmology. As against this, physics where this idea comes from, has undergone revolutionary

changes in the discussion of methods and has gained new insights. (Fig. 5)

As can be seen in the figure, we distinguish the following 4 categories, which can be used as premises to explain and justify pathological processes, such as macular degeneration. These categories are:

- a). mechanics (like a clockwork)
- b). regular wave movements
- c). chaos theory (cloud movement)
- d). catastrophe theory (hurricane, according to the French mathematician R. Thom)

4. The Structural Method for a General Theory of Visual Movements

While the inductive method tries to reduce organ functions to the simplest possible level, the structural method works the other way round. It shows the relationships and interrelationships of the functional elements and then formulates a general theory. It proceeds from part to whole, from simple to complex and from linear to non-linear.

Conventional ophthalmology reduces the functions of the eye to the principle of the camera and separates the anatomical-physiological unit of eye and brain from each other. In contrast, our structural approach defines the eye as the **guiding organ of the entire body** and thus goes far beyond the mere connection between eye and brain. (Fig.6)

Especially when working continuously at close range, this becomes apparent in the posture determined by the act of seeing.

In our empirical study of workers in five sewing factories in Northern Germany, we were able to prove this by means of ophthalmological examinations and exact measurements directly at the workplace. (Fig.7)

As an important result of this study we were able to point out the connection between eye head and body posture and explain the head, neck and eye pain of many seamstresses, which could not be verified by usual ophthalmological examination until then. This new disease discovered by this study, we called the **ocular-cervical syndrome**. (Fig. 8) Especially in the industrialized countries, this problem that has become a widespread disease.

5. Discussion of Methods

The discussion of methods is an important step to clarity and progress of a scientific field.

In 1929, the **Vienna Circle** of Logical Empiricism published its manifesto "The Scientific World View". It contains an interdisciplinary and international dialogue between scientific philosophy and the exact sciences. All disciplines were represented in the Vienna Circle, with the **exception of medicine**. This may be one of the reasons why ophthalmology has ignored this direction of basic research. Until today, there is no method analysis and method criticism in this field. Results of experiments and measurements usually claim objective validity and thus acquire a normative character.

An example from medicine is the letter combination Rp, which appears on every prescription. It comes from Latin and means the command form of take (recipe = take!). This expresses an authoritarian behavior that has been maintained in many areas of medicine up to the present day.

The legalization of scientific hypotheses and opinions is expressed in regulations and laws. This is an anomaly that we have highlighted in our manifesto "Global Science in the 21st Century".

The history of science is characterized by trial and error, and thus by the fundamental provisional nature of all knowledge. This deeply contradicts the attempts of university institutions to dogmatize scientific statements. The consequence of this is the monism of methods up to the compulsion of methods (Methodenzwang, Feyerabend) in medicine. While other disciplines have subjected their methods to a critical review, in ophthalmology only one method is still considered scientifically recognized. This is the double-blind study with preferably many thousands of test persons, an unacceptable one-sidedness.

Literature

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Logic of Scientific Discovery in ophthalmology-Work

Logic of Scientific Discovery in Ophthalmology

FIGURES

THE CURRENT SITUATION OF PURE BASIC RESEARCH – Logic of scientific discovery

<u>Forms of logic</u>	<u>Methodology as Procedure</u>	<u>Results</u>
1. Deductive Logic Aristoteles (384-322 a.c.)	1. Axiomatic Method	1. Stringency, Certain of Ideas
2. Inductive Logic J.St. Mill (1843)	2. Experimentation, probability, Statistics – from particular to general	2. Laboratory experimentation on animals and human beings
3. Polyvalent mathematical Logic (Logistics) - Whitehead & Russel (1910)	3. Artificial language (symbols) (as well – as, Antinomies)	3. Logicism, Formalism (Frege), Intuitionism
4. Fuzzy-Logic (unclear Premises) Zadeh, Goguen, Kaufmann u.a. (1960 -)	4. Everyday Language, Metaphors (Proverbs)	4. Style + Niveau of Language
5. Dialogic (common sense) Sokrates, Sophists	5. Method of Argumentation (Topic + Rhetoric)	5. Balance of Opinions, human engineering
6. Dialectic Logic Herklit (544-483 a.c.), Hegel (1812)	6. Dialectic Method (Communist Manifesto dialectical and historical Materialism)	6. Political Philosophy, October revolution 1917
7. Pragmatical Logic John Dewey (1938)	7. Cognition of problems + solutions, Priority of Practice, (Praxiology)	7. Utility, application (Operationa- lism) Bridgman
8. Structural Logic – de Saussure 1916 (Linguistic) Levi-Strauss	8. Relationship of Elements Teleology, Functional Context Observation, Behaviorism	8. Linguistic, Anthropology, structural Ophthalmology
9. Primary Modal Logic (Leibnitz)	9. Possibility, Reality Neccessity	9. Realism, conventional Rationalism
10. Secondary Modal Logic (Sradj 2013)	10. Unthinkable, Impossible Parallel Reality	10. Negative Dialektic, Surrealism Irrationalism

Fig. 1: Comparison between inductive logic of conventional Ophthalmology (no- 2) and structural holistic approach (No. 8)



Fig.: 2 Cardanic suspension explaining the eye movements according to the mathematician Listing (1850)

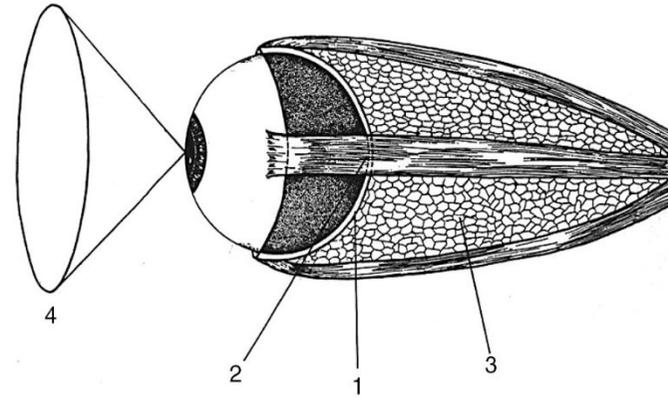


Fig. 3: Socket Joint model explaining the theory of eye movements including cyclorotations and translations

Name:

Datum:

Diagnose:

Bemerkungen:

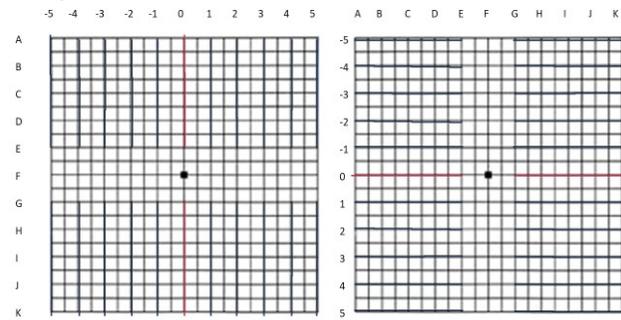
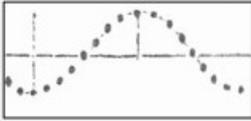
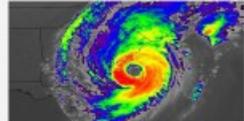


Fig. .4 : Quantification of the Amsler Test, a new way for measurement of metamorphopsia differentiating between horizontal and vertical lines

PHYSICAL MODELS

APPLICATION OF PHYSIOLOGIC AND PATHOLOGIC PROCESSES (SRADJ)

Mechanics 	Thermodynamics 	Chaos Theory 	Catastrophism 
Metrics Causality Destruction Reversibility	Wave Motion Entropy Entirety From order to disorder	Cloud Motion Irregularity Instable structure Irreversibility	Hurricane Acausality, sudden change Destruction Self-Organisation
Forecasting possible Consistency	Short-term forecasting -----	Difficulty in forecasting -----	No forecasting No Consistency
Newton Galilei	Boltzmann Prigogine u.a.	Mandelbrod u.a.	Thom SFO Paris 1992

Result: The models can be applied to chronic diseases such as macular denegeration

Literature: Biophthalmologie, annual report of the French Ophthalmologic Society (SFO) Paris 1992

Fig.5

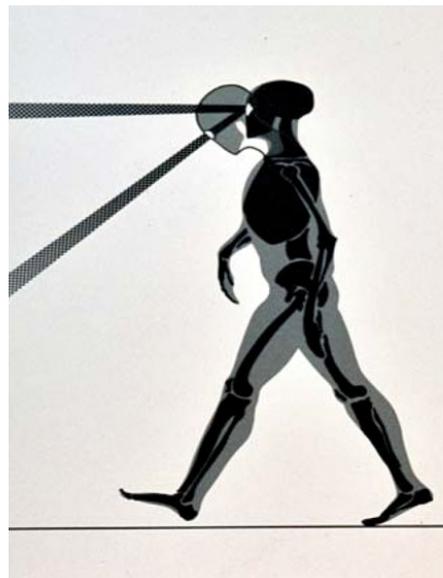


Fig.:6 Structural Ophthalmology considers the eye as a directive organ of the whole body



Fig.7: Women at work in a textile factory in Northern Germany under permanent head depression and head inclination.
Application of structural observation method under natural conditions.

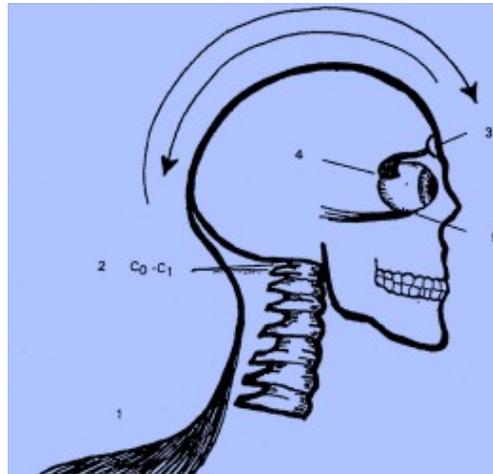


Fig.8: Symptoms of the ocular- cervical Syndrome: **Myalgia of the eye muscles, pain in the atlanto-occipital-articulation, retro bulbar pain.**
These complaints are often erroneously explained as „dry eye“.