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Ockham's Razor and its Improper Use

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Abstract – "Ockham's razor" is a methodical principle, due to the medieval philosopher William of Ockham, who mainly opposed an unjustified creation of new terms in philosophy. Since this principle and its later versions are frequently quoted in discussions about anomalies, it will be studied here in some detail. After a short look on the historical roots, the principal modern formulations are summarized. It will be shown that a demand for "simplicity" cannot be generally maintained. Rather, striving for simplicity can conflict with other essentials of scientific method. Ockham's principle - no matter whether in its original or in a modified version – cannot be helpful in a rational decision between competing explanations for the same empirical facts. An incorrect use of Ockham's razor only leads to a perpetuation and corroboration of existing prejudice, and this principle should not be used to easily get rid of unwelcome data or concepts.

Keywords: Ockham's razor – anomalies – misinterpretation of empirical facts – principle of simplicity – economy of thinking – perpetuation of prejudice

1. Misinterpretations of Empirical Facts – a Recurrent Pattern

In discussions about the existence or non-existence of classes of controversial phenomena, about a correct interpretation of empirical data, but also about the adequacy of newly created terms, intended for purposes of explanation, permanently a principle is quoted which is generally known as *"Ockham's Razor"*. In the sequel – after a short glimpse on the historical roots – the reach and the limitations of this principle will be explored, particularly in its modern understanding.

Among the many dysfunctions of science, one specific pattern shall be scrutinized in more detail. A significant proportion of the errors and misunderstandings in the history of science – until very recent times – can be understood as *misinterpretations of empirical facts*. In a first approach, one can identify two categories:

- The erroneous recognition of phenomena (e.g., N-rays, polywater, Piltdown man),
- The unjustified rejection (e.g., meteorites, ball lightning, continental drift, inverse transscriptase).

2. Ockham's Principle – Original and Revised Versions

William of Ockham (about 1280 – 1349) is deemed one of the most important philosophers of the 14th century. *Ockham's Razor* is a "methodical principle, particularly in the context of ontological issues, according to which philosophy and science should assume as few theoretical entities as possible for purposes of explanation, explication, definition, etc." (Gehtmann, 2004). It appears in two versions: "Pluralitas non est ponenda sine necessitate" (A plurality should not be claimed without necessity) and "Frustra fit per plura, quod potest fieri per pauciora" (In vain is done by many things, what can be done by few); the frequently cited form "Entia non sunt multiplicanda praeter necessitatem (sine necessitate)" (Entities must not be multiplied beyond necessity) does not occur in Ockham (Thorburn, 1918; Schwemmer, 2004).

The original meaning of this principle can be understood only in the context of the philosophical and theological debates of the time of Ockham, especially on the "problem of universals". Above all, Ockham opposes pseudo-explanatory or otherwise meaningless and superfluous terms. But a clear view of the authentic intention is blocked by modifications and re-interpretations of later times not consonant with the primary source. Essentially three basic patterns of the later versions can be identified, which, of course, partially overlap:

- The *principle of parsimony* comes closest to the original version by demanding cautious discretion before the creation of new terms and concepts.
- The *principle of simplicity* (economy of thinking, according to Ernst Mach) aims at explanations, reasons, theories, etc., which should be as simple as possible.
- Closely related with the latter is the demand for an *exclusion of unnecessary additional hypotheses*.

3. Simple or Fitting Systems of Terms?

Already in Ockham's lifetime, Walter of Chatton, his fellow in the Franciscan order, voiced contradiction: "If three things are not enough to verify an affirmative proposition about things, a fourth must be added, and so on". Later on, other authors in a similar manner advocated a "principle of plenitude" (Maurer, 1984). The mathematician Karl Menger (1960) formulates a "law against miserliness" and demonstrates that occasionally too many different concepts are united under one single term (e.g. "variable").

The demand for a functional, sufficiently differentiated system of terms is generally accepted meanwhile, as well as the warning against neologisms "beyond a necessary scale". Stupidities in terminology sometimes occur as a "show vocabulary" within new fields of science struggling for recognition, and as an in-group slang pursuing motives of group dynamics and not of scientific logic. Still controversial, however, are concepts like "simpler theory" and "unnecessary additional hypothesis".

4. The Myth of Simplicity

4.1. The Scientist and the "Unknown Unknown"

Normally, an explanation becomes necessary when a surprising and unexpected phenomenon is observed, and an explanation has to do away with this element of surprise. (Kim, 1967, p.

162). The philosopher of science Henry H. Bauer (1992, p. 74-76) disputes the common view that scientists are open-minded and strive for new cognition and insight. By way of contrast, he states that open-mindedness for the new exists only as long as the new things are *not too new*. Bauer makes a distinction between the "known unknown" which can be derived from secured knowledge (and hence is suitable for research proposals), and the *"unknown unknown"* that cannot be expected on the basis of the state of knowledge. On the basis of psychological experiments, Krelle (1968, p. 344-347) characterizes a limitation to the human capacity of information processing under the term "conservative distortion". Particular and deviant features are perceived insufficiently, and "valuations accepted before" are maintained.

So it becomes understandable why the existence of meteorites and ball lightning originally was rejected. The scepticism against reports supplied by laymen (Westrum, 1978) induced a persistent deterioration of the faculty of judgement, such that later on also substantiated evidence and expert's reports – like specimens of meteorites and chemical analyses – were dismissed under the same prejudice. Being accustomed to categorize phenomena within the usual conceptual and explanatory schemes, scientists easily run the risk of a *reductionist trap*, finally being content with a sloppy categorization, however wrong it may be.

As victims of this characteristic mechanism, scientists have acted dramatically against their own interests. We find the recurrent pattern of the "discovery before the discovery". At least three renowned chemists produced oxygen before its detection was generally accepted, but erroneously classified it as some well-known gas. In at least 17 cases a new celestial object was registered before it was finally recognized as a new planet (Uranus), and similar errors happened before the "definitive discovery" of the planet Neptune and the X-rays (Kuhn, 1962). In 1995, two American astronomers made observations suggestive for a planet outside our solar system, but did not further pursue their discovery. So other astronomers could be the first to publish their independent discovery and claim to have identified the first extrasolar planet (Schneider, 1977).

4.2. Nearness Distortion – a Characteristic Pattern of Misunderstanding

When humans try to interpret a phenomenon, they are always at risk of "falling short", of adopting explanations close to their individual range of prior experience. This can be documented by a series of episodes from history.

Galilei categorically opposed the idea that the tides have something to do with the moon (gravitational theory of tides), and tried to develop his own, purely terrestrial theory instead (Harris, 1967, p. 228). A explanation was highly desired also in the meteorite controversy. The true debate began in 1794 when the German physicist Chladni published a small book advocating the reality of meteorites, and in the same year a widely publicized case took place in Siena, Italy. But Chladni and all other advocates of the reality of meteorites were under permanent attack. Even scholars who were up to the standards oft their time tried to contrive explanations which were destined to circumvent the idea that material can fall from sky: e.g., meteorites "were caused by the ignition of long trains of gas in the atmosphere", or by "hurricanes and volcanic explosions". (Westrum, 1978)

The "Nördlinger Ries" is a singular geological formation in Bavaria (Southern Germany). In our modern understanding it is an impact crater, nearly circular, with a diameter of about 24 kilometers. For a long time the problem of its origin had puzzled the experts. For this puzzle, too, a lot of possible terrestrial interpretations were thought up, e.g., a volcano that had meanwhile disappeared, an "explosion hypothesis", a "glacier-grinding theory", etc. Only after 1960 was the impact of a cosmic object ("metereorite theory") – now generally accepted – seriously discussed. (Dehm, 1969)

This recurrent pattern of misinterpretation can be dubbed the *nearness distortion* for short. As a matter of symmetry, there is also a trend towards "far-fetched reasons", particularly in some groups that are inclined to quickly assume extraterrestrial or subterranean origins.

4.3. In Search of a Simplicity Criterion

The symmetrical terms "simplicity" and "complexity" are *perspective notions*: their meaning in a single case depends – beyond the well-known context-dependence of any word meaning – on the context of application and the user's prior understanding (Gernert, 2000). For the present purpose, a comparative measure would suffice that marks one of two possible explanations of an empirical fact as the "simpler" one. But even such a comparative measure is feasible only in limited contexts within a formal science (e.g., in the comparison of two formulas of a logic calculus); a measure of complexity will immediately provoke reservations as soon as relationships with empirical data come into play.

The degree of simplicity of a curve equation can be defined by the number of free parameters: a circle in the plane gets the measure 3, and an ellipse gets the number 5. On the basis of simplicity we would have to prefer circular planet orbits to Kepler's ellipses. Simplicity and precision are conflicting demands. Furthermore, a measure of simplicity depends upon a predefined scheme. In a task of curve fitting, given a set of measurement points, a reasonable curve is to be determined. If a fixed task requires, in a first step, to express such a curve by a polynomial, whereas in a second step also sin(x), log(x), etc., will be permitted, than the latter representation will be "simpler", but at the price of more complex means of expression. On the other hand, the simplest answer – maybe a straight or slightly curved line – is not always useful: for the quantum Hall effect just the extrema of the curve are relevant. The theory of complexity is not helpful here. In the literature we find various definitions of "complexity", each of which is tailored to a specific purpose of application; each of them is related to its specific class of formally defined constructs, like algorithms or series of signs.

The problem to decide between competing explanations for empirical facts cannot be solved with formal tools. Can a neutral procedure be imagined, to assess the issue of ball lightning, still controversial some decades ago: Is ball lightning real, or are the reports by laymen altogether based upon deception?

In an extensive monograph, Mario Bunge (1963) reveals the diverse shortcomings and limitations of a principle of simplicity. In detail he demonstrates that a demand for simplicity (in any of its facets) will conflict with other essentials of science (as exemplified in the case of curves above by a conflict between simplicity and precision). Finally he speaks of a "cult" or "myth of simplicity". With respect to Ockham's Razor, Bunge recommends caution: "In science, as in the barber shop, better alive and bearded than cleanly shaven but dead." (p. 115)

4.4. What Ockham's Principle Cannot Accomplish

The principle of simplicity, no matter in which version, does not make a contribution to a selection of theories. Beyond trivial cases, the term "simplicity" remains a subjective term.

What is compatible with somebody's own pre-existing world-view, will be considered simple, clear, logical, and evident, whereas what is contradicting that world-view will quickly be rejected as an unnecessarily complex explanation and a senseless additional hypothesis. In this way, the principle of simplicity becomes a *mirror of prejudice*, and, still worse, a distorting mirror, since just this origin is camouflaged.

As an example, an advocate of the geocentric system could argue: some easiness in the calculation of planetary orbits is irrelevant, because we are not obliged to adapt our world system to the mathematicians' wishes for comfort, and the hypothesis of a moving Earth is an unnecessary – and adventurous – additional hypothesis, not at all supported by any sensual perception.

Walach and Schmidt (2005) propose to complement Ockham's Razor by "Plato's lifeboat". This principle, with its origin in the Platonic Academy, claims that a theory must be comprehensive enough "to save the phenomena"; this was triggered by observed anomalies in planetary motion.

Our world is more multi-faceted than some people may imagine. The critical point is not only the frequently cited "more things in heaven and earth…", but simply the adequate explanation of material at hand. Further misinterpretations are certain to come. But the principle of that honourable mediaeval philosopher should not be misused as a secret weapon destined to smuggle prejudice into the discussion and to easily dismiss unwelcome concepts.

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