"Water is one individual thing – it never changes"
Quoting Faraday in the PI: A riddle with a Goethean solution?

Nikos Psarros, Philosophical Institute, Univ. of Leipzig, Burgstr. 21, D-04109 Leipzig

Erscheint in: *Wittgeenstein Studies*, in Vorbereitung.

1. A curious remark

In the standard editions of PI, one finds at the bottom of §108 a curious remark: "Water is one individual thing – it never changes". This remark is a quotation from M. Faraday's famous lectures about the *Chemical History of a Candle*. These lectures were delivered several times to audiences of young people at the Royal Institution in London, the last occasion being at Christmas 1860.[1] The aim of the lectures was to give an exact and correct account of the elemental composition of the candle material and of the products that are formed during the combustion process. This should happen, however, in a manner that was comprehensible also by people who are not familiar with the chemical nomenclature and the chemical theories. The lectures had introductory character. They were intended to evoke the interest of the audience for the science of chemistry avoiding crude popularisation. For this reason, they were accompanied by "pedagogically" designed experiments that helped demonstrating Faraday's claims.

One of these claims is that when the material of the candle burns it produces a liquid that Faraday identified as water. This combustion water, he

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[1] Faraday 1993, Intro by J.A. Thompson

asserted, is the same substance like the water obtained from any other source, either by combustion of oil, or gas, or ice, or steam, or from common pond water or sea water by distillation.[2]

How did Faraday convince his audience that the water-like liquid obtained from the candle flame was really water? He let an amount of it (some drops) and an amount of "real water" react with metallic potassium demonstrating thus that both substances showed with potassium the same chemical behaviour: flames and explosions. Faraday used this circumstance as evidence for the statement that found its way into the PI: "Water is an individual thing – it never changes". Faraday continues: "We can add to it by careful adjustment, for a little while, or we can take it apart, and get other things from it; but water, as water, remains always the same, either in a solid, liquid, or fluid state".[3] In the further course of the lectures, Faraday repeats this assertion – that all water-things are identical regardless of their state and of their origin – several times. He uses it as a kind of "warrant" that renders possible that the results of the chemical analysis of an arbitrary chosen water sample[4] can be extrapolated to the water obtained from the candle. Faraday succeeds thus in demonstrating that the hydrogen in the combustion water stems from the material of the candle and the oxygen from the air. With a similar experimentally sustained argumentation, Faraday also showed that

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[2] "[A]lthough you may now be acquainted with all its forms, they still require us to give a little attention to them for the present, so that we may perceive how the water, whilst it goes through its protean changes, is entirely and absolutely the same thing, whether it is produced from a candle, by combustion, or from the rivers or ocean" (Faraday 1993: 52).

[3] Faraday 1993: 51.

[4] In one point, however, there is no arbitrariness: it has to be a sample of distilled water. Why this has to be so, see further in the text.

the other major component of the candle material is carbon. Burning a candle results in water and carbon dioxide. Prerequisites for this conclusion are, however, the proof and the acceptance of the fact that the combustion products of the candle are identical with water and carbon dioxide from other sources. With other words, writing the *Chemical History of a Candle*" (in a modern chemical sense) is rendered possible only by providing criteria and methods for ensuring the identity of substances beyond the limits of individual things and of their states. Only when this condition is fulfilled can we proceed to chemical analysis.

2. *Mehr Licht* with Goethe?

The function of Faraday's remark in the PI is opaque. It is not even clear to which paragraph it was originally attached. Baker and Hacker mention that in the manuscript and typescript versions of the PI it was attached to §223 of the published version. This paragraph belongs to the section where Wittgenstein tries to elucidate the concepts of rule and of following a rule. In particular §223 states that following a rule does not imply that we are always conscious of doing so. In the contrary, our attention is normally directed towards the situation (or the object) that we wish to reproduce within the framework of a routine: We do always the same and our success in reproducing the action enables the inference that we are following a rule. This view is strengthened by an additional remark that was omitted from the published version of §223: "One could say: we look at what we do when we follow a rule from the perspective of *always the same*".[5]

In the published version of the PI, however, the Faraday remark appears connected with §108. This paragraph belongs to a section that is concerned with the relevance of logic for the treatment of philosophical problems. Af-

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[5] Baker and Hacker 1985: 221. English translation by the authors, Italics in the original.

ter having shown, that the ideal language of logic is too "smooth", too "ideal" for providing a useful ground, Wittgenstein presents in §108 and the following paragraphs his method of treatment that consists in the "description of the facts of language and its use".[6] In §108 Wittgenstein outlines this task as giving an adequate account of what "proposition", "word", "language" is, by describing their use and not their properties. In §109 he stresses the point that philosophical analysis should be done in the modus of *describing* and not of *explaining*.

At a first glance, the Faraday remark seems to be unrelated to both §108 and §109. Taking into consideration that it has been removed inside the text from a place where it looks more adequate (we do always the same – water is always the same) to a place that is of more programmatic character (what is a proposition or a word should be described by its use and not explained by its properties) the question arises about the motive for this removal.

In their *Analytical Commentary on Wittgenstein's Philosophical Investigations*[7] Baker and Hacker associate the Faraday remark with a passage in Goethe's essay *Die Metamorphose der Pflanzen*. Goethe tries there to provide a general explanation of the construction scheme (Bauplan) of the plants by referring to the leaf as the structural unity of the plant body. According to him, plant organisms consist only of one single type of organ or tissue that takes various forms and functions in fulfilling the different tasks that are necessary for sustaining the life and the reproduction of the organisms. The development of the individual plant organism is regarded as a series of transformations ("metamorphoses") of this unit. This view is expressed clearly in §115 of the essay: "However plants may sprout, bloom or bear fruit, it is always just the

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[6] Baker and Hacker 1985: 219.

[7] Baker and Hacker 1985: 222.

same organs that in manifold ways and many variable forms manifest nature's pattern. The very same organ that unfolds on a stem as a leaf and assumes the greatest variety of forms is contracted into a bud, develops into flower petals, is contracted into the sexual organs, in order to develop finally the fruit". In §119 he resumes his program: "In the same manner, in which we tried to explain the manifold organs of the sprouting and blooming plant from the *leaf* that normally develops at the knots; in the same manner we dared to deduce from the form of the leaf also those fruits that use to encapsulate their seeds tightly".[8]

Baker and Hacker claim that both statements, Faraday's asserting the interchangeability of all water things with respect to their utilisation in chemical investigations and Goethe's asserting the hidden sameness of phenomenally unrelated and quite dissimilar body parts, are expressions of the same idea of underlying identity "in terms of which the diversity of the phenomena can be *explained*".[9] Faraday's assertion proved to be a fruitful hypothesis (a realistic scientist would say a true one), while Goethe's one led him on the wrong track. It is important here to keep in mind that – according to Baker and Hacker – both "hypotheses" can be tested empirically.

On the background of this interpretation, Baker and Hacker's suggestion for the relationship of Faraday's remark to the text of §108 is that it should be read in a critical manner. Faraday's "Water-is-an-individual-thing"-program should be read as a reminder of the early attempts Wittgenstein's in the *Tractatus* to find a "formal unity underlying proposition and language"[10] that

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[8] Goethe 1998: 101. Translation of §115 by Baker and Hacker, §119 by the author, Italics in the original.

[9] Baker and Hacker 1985: 223.

[10] Baker and Hacker 1985: 223.

in PI are given up in favour of a descriptive analysis. The association resp. comparison with Goethe's "all-plant-parts-are-leaves"-program serves the purpose of elucidating this point. Baker and Hacker were motivated to use this quotation from Goethe because "W. was well acquainted with Goethe's essay and the corresponding poem".[11]

3. The status of identity in Faraday and Goethe's theory

Baker and Hacker's association of Faraday's remark with Goethe's statement about the constitution of the plant body appears at a close look as questionable. The adequacy of their interpretation relies on two premises, namely the fact that Wittgenstein knew Goethe's essay *and* the assumption that both statements are different explications of the same idea. The first premise, although uncontroversial as a fact, is, however, not sufficient for supporting Baker and Hacker's view. The crucial point rests in the validity of the second premise. If it were true then it would be alone sufficient for sustaining Baker and Hacker's interpretation independently of the fact that Wittgenstein was familiar with Goethe's work or not.

In order to settle the matter we should ask about the *status* of identity in Faraday's and Goethe's theories. Faraday claims that all things that display a certain "bundle" of properties consist of the same substance, namely water. Goethe on the other hand claims that a number of phenomenally and functionally different anatomical features of the plant body are "in reality" forms of appearance of the same thing, namely the 'theoretical leaf'.[12] The identity among Faraday's water-things is constituted by restricting the attention to this "bundle" of properties that can be found by examining the contents of

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[11] Baker and Hacker 1985: 222, footnote 20.

[12] I use here the term 'theoretical leaf' in contrast to the real leaves that are also manifestations of the theoretical ones (Cf. Die Metamorphose der Pflanzen §119).

the phenomenal world. Therein are included properties like 'liquid', 'density of 1 g/cm^3 at 4°C', 'colourless', 'tasteless', 'having affinity to potassium', 'solvent of salt' etc. The things that are candidates for "consisting of water", however, have to display these properties in a certain manner, namely they must be homogeneous with respect to them. This means that randomly chosen parts of them have to be indistinguishable with respect to the listed properties. A number of things that are homogeneously liquid, colourless, tasteless, having affinity to potassium, are good solvents of salt and have at 4°C a uniform density of $1g/cm^3$ can be regarded as being *equisubstantial* with respect to those properties. Equisubstantiality is a reflexive, symmetric and transitive *equivalence relation*.

We can now introduce the term 'substance' by restricting our language on the particular contents of the equivalence relation 'equisubstantial', with other words by defining that every thing that is homogeneously liquid, colourless, tasteless, having affinity to potassium, a solvent of salt, and has at 4°C a density of 1 g/cm^3 consists of the same substance, namely water. Faraday makes, however, a further step and demands that the liquid or gaseous state should also be omitted from the list of homogeneous properties that make up equisubstantiality. The reason for this is that Faraday follows a certain program, a program that seeks to create a genealogical relation between substances. The aim of this *chemical program*[13] is to render possible the reproducible and predictable synthesis of a given substance from other substances and its analysis to other substances. Because of the nature of the methods that are involved in chemical synthesis and analysis, the candidates for such a genealogy have to retain their 'substantial identity' after a transformation of state. Honey or milk for example cannot be restitued substantially after boiling or freezing, water does. By removing the state from the

[13] For more details about the chemical program cf. Psarros 1999.

list of the conditions that make up equisubstantiality we constitute the actual objects of chemical investigation, the so-called *chemical substances*.[14] Now Faraday's claim that "water is an individual thing" turns out to be nothing more and nothing less than the *prescription for a particular way of describing the world for a given purpose*, namely the construction of the genealogy of substances. The identity of all water-things rests in their interchangeability with respect to a certain number of properties that enable their utilisation for the chemical program. Using a different terminology, we can say that the identity of water things is identity with respect to an *abstract* 'entity', the chemical substance water.

It could be objected at this point that this reconstruction is not applicable to Faraday's ideas because he speaks of water in an ontic manner, namely as a world-embracing thing. The term 'water' he uses should be regarded therefore as a mass term in a Quinean sense. However, the ontic interpretation cannot be supported by the text. Faraday seems to be aware of the circumstance that the identity of water-things is constituted in a chemical language game: "[...] we philosophers speak of water as water, whether it be in its solid, or liquid, or gaseous state – we speak of it chemically as water".[15]

Turning again to Goethe, we notice now that his assertion that all organs of the plant are manifestations of the theoretical leaf has a completely different

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[14] Does the transition from substances to chemical substances mean that in the list of properties that makes up equisubstantiality predicates like 'solvent of salt' have to be omitted because they are bound to a particular state (here the liquid state)? Chemists normally do not wish to do without such central properties that are very important also for theoretical considerations. They remain in the list by specifying the conditions of applicability in a law-like sense. The correct description of the mentioned property is then 'in the liquid state a good solvent of salt'.

[15] Faraday 1993: 51.

status. The theoretical leaf is a postulated entity that shall provide the integration of a variety of botanical phenomena in a single theory. The theoretical leaf is not part of a descriptive language, but of an explanative one. Its introduction and use requires that the phenomena it helps integrating in the theory have to be described already in an appropriate manner. *They* are the objects of examination, like water and the other chemical substances, which Faraday uses in composing *the Chemical History of a Candle*. In its function as a postulated, thing-like principle of explanation and theoretical integration, the theoretical leaf has not the semantic function of an abstract entity, but of a *theoretical construct*.[16] It cannot be 'abstracted' from a number of objects that share a number of properties, it does not constitute a restriction in the way of speaking about individual objects. The theoretical leaf is an individual object by its own right, but a fictitious one. For this reason, it cannot be observed directly. Every object that belongs to the realm of its explanatory application is its manifestation, even a real leaf. What is more, for recognising a plant part as its manifestation, one has to give the *mechanism* of the manifestation of the observed object. In a certain sense, the theoretical leaf *is* the theory of the metamorphoses of the plants.

The identity of all water-things is a concept that is *applied* to the world in order to enable its description. The identity of the plant organs as manifestations of the theoretical leaf is a concept that rests *beyond* the world awaiting to be discovered. The identity of the water-things is of the kind of a rule in a language game; the identity of the organs of the plant is an empirically testable assertion. In this sense, the theoretical leaf is a construction like atoms, molecules,[17] or the ancient Empedoclean elements.

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[16] The term 'theoretical construct' is due to Hartmann 1993.

[17] For an account of how the concepts of chemical atom and chemical molecule can be reconstructed as theoretical constructs cf. Psarros 1998.

4. Wittgenstein, Faraday and Goethe: Interplay with fence-rider

On the background of the distinction between the identity of objects as abstract entities in a descriptive language and the identity of objects as manifestations of a theoretical construct in an explanative language, placing the Faraday remark in the context of §108 and §109 appears as adequate and reasonable. Wittgenstein argues in §108 that linguistic facts are constituted by giving the rules of their use and not by describing their properties. In §109, he outlines the method of the philosophical investigation as describing and not explaining. Faraday proceeds in an analogous manner. Speaking in Wittgenstein's terms, we could say that by stating that "water is an individual thing" he points to the circumstance that the use of the word 'water' in the chemical language is determined by rules. The properties of water are explicated by them. Faraday constitutes the chemical facts – the chemical substances – by giving rules for their reproducible preparation, both in the language and in the world. Chemical facts are prerequisite for describing the chemical phenomena that make up the *Chemical History of a Candle*. Here the aims of Wittgenstein and Faraday aims coincide again. For, writing the *Chemical History of a Candle* does not consist "in providing new experience, but in rearranging of that what is already known"[18]. In this interplay between Wittgenstein and Faraday, Goethe remains a fence-rider.

5. References

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[18] PI 109.

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