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GOETHE'S PLURALISM: TRUTH OR A SLIP OF THE TONGUE?

– ON SOME RESEARCH TRADITIONS IN THE FIELD OF COLOUR VISION–

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Abstract

Where are colours? Inside, outside or somewhere in between? Using Goethe's criticism of both the objective (Newtonian) and subjective (as in the works of Schopenhauer) treatment of colour phenomena the author aims to give a criticism of both. While doing so he compares two such criticisms, one by a recent writer (EVAN THOMPSON 1995. *Colour Vision. A Study in Cognitive Science and the Philosophy of Perception*), one by a turn of the century interpreter of Goethe (Rudolf Steiner, editor of the Weimar edition of Goethe's scientific writings). The aim is to investigate and compare these criticisms, two solutions for a relationist science of colours.

Keywords: vision, colour, visual science, research traditions, J. W. Goethe, E. Thompson, R. Steiner.

> 'For at this moment I am sensible that [..] like the vulgar, I am only a partisan. Now the partisan, when he is engaged in a dispute, cares nothing about the rights of the questions, but is anxious only to convince his hearers of his own assertions. And the difference between him and me at the present moment is merely this – that whereas he seeks to convince his hearers that what he says is true, I am rather seeking to convince myself'
>
> Plato: *Phaedo*

1. Goethe's Attachement to Pluralism in Science

Goethe's polemic against Newton is well known. He loathed the French Revolution, Catholicism and the Newtonian theory of light and colours[1], for, in his eyes all three were despotic and tyrannical. In a letter to J. F. Reichardt on 30 May 1791 he wrote:

> 'Of all my projects, the one which interests me most is a new theory of light, shade and colours. If I am not mistaken, sometimes even revolutions must come about in the studies of nature and art.'

He was hoping for such a revolution, which would lead to a Republic, as it preserves a measure of independence, and because it is characteristically liberal, not tyrannical. And this should not be taken only politically. As Jackson pointed out (1994:680) 'He wanted to establish a republic in colour theory so that a group of learned investigators of nature could voice their opinions', similar to the members of the French Republic of Letters. And to reach this the Newtonian despotism had to be overthrown.

2. Goethe's Intolerance: Preaching Water, Drinking Wine?

But his attempt to liberate colour science from the Newtonian heritage has clearly failed in his time. Both his *Beitrage zur Optik*, aimed at simply reinvestigating Newtons *experimentum crucis* with his own prismatic games, and the gigantic *Farbenlehre* was a failure. The reasons for its nearly total refusal, however disturbing, were understood by Goethe as a consequence of the rigid structure of the scientific community, 'the ethos of academy' (Fink 1991:132), and the power of the Newtonian authority.

This is the better known part of the story. The multi-talented genius, who is not understood and accepted by his time in the field of Natural Science, the area, where he was probably most proud of his contributions. We can sympathise with Goethe, and in the light of current research (like SEPPER 1988, REHBOCK 1995) even side with him. To rephrase his claim: science can flourish if there is an open community of researchers following different but equally justified research programs, instead of one canonized approach trying to eliminate all other attempts and ways of tackling a certain problem, claiming absolute certitude and justifiability, labelling every attempt to falsify it nonsensical.

But then how do we understand his attitude to Arthur Schopenhauer, who was one of the few to support his theory. Schopenhauer wanted to

[1] One of Goethe's main arguments against the Newtonian way of dealing with colour phenomena, is that '...the whole no longer resembles a free republic but a despotic court circle' in his essay *Der Versuch als Vermittler* ... translated in Mueller (1959, pp. 220–227)

further develop Goethe's theory of colours[2], and, on the basis of Goethe's presentation of the phenomena, following the footsteps of Kant's Critique of Pure Reason claimed the *Farbenlehre* for physiology (Magnus 1906:127). Schopenhauer, who, like a true young rebel took sides with Goethe in the question of colours, was one of the very few supporters of the Goethean program, and yet, when he sent the manuscript of his first essay on '*Vision and Colour*', after reading it Goethe was reluctant to send it back (even after several reminding letters by Schopenauer). Goethe, instead of welcoming a thinker of very similar ideas, condemned Schopenhauer as a heretic[3]. This is the lesser known part of the story.

Goethe, the advocate of the 'scientific republic' turned against his own disciple in a war that was already to be lost, and where he was left with very few allies. Isn't this move exactly the same as Newton's move was towards his contemporaries trying to question him? And is this not the same attitude (on Goethe's side) of the 19th century Newtonians that neglected and condemned Goethe's own writings in his time?

This paper is about the seeming contradiction between Goethe's tolerance and intolerance, about the success of the very views condemned by Goethe, and two attempts to find a better truth. One is Evan Thompson's (ET), co-author of the famous *The Embodied Mind* (1991. Cambridge, MIT Press) with Varela, F. J. and Rosch, E. As his book will be frequently cited the numbers in brackets refer to page numbers in his book (THOMPSON, 1995). The other is Rudolf Steiner's (1861-1925), one of the most influential and controversial interpreters of Goethean Science, working for years in Weimar, in the Goethe Archives, preparing the Weimar Edition of Goethe's writings. The four volumes of the scientific writings edited by Steiner are still famous and among the most often used.

3. The Weeds Flourish

Ironically enough Goethe has condemned the two most significant and successful research programs of colour vision. One has grown out of the Newtonian assertion that colours are contained in white light, and can therefore be labelled as 'objective' approach. The other can be dated from Johannes Müller's book on '*The Comparative Physiology of the Visual Sense in Man and the Animals*', appearing in 1826, only ten years after Schopenhauer's '*Vision and Colour*'. This approach we might term physiological, or subjective.

Both views became extremely popular and useful in the development of

[2]See his letters written to Goethe in the year 1812

[3]Rudolf Magnus finds the reason in Schopenhauer's assertion that white light can be obtained by the mixture of spectral colours (Magnus 1902:195). But, as this paper attempts to show, there might be oher reasons for Goethe's rejection.

the science of colour. They managed to tackle different problems, abounded in good solutions given to very puzzling questions. To our further discussion let us outline the problem- space and some of the recent achievements of both programmes.

3.1. Computational Objectivism

Trying to model the way the human or another visual-system works has been a prime concern of computational models of colour vision. To carry out the necessary calculations computational studies have to 'quantify' colour. It is generally agreed that colour perception can be described by three parameters: that of hue, saturation and lightness. Ordering numbers to each of these we arrive at the so-called 'phenomenal colour space' a three-dimensional colour solid, where every point of the solid corresponds to a colour sensation.

According to Computational Objectivism (CO), this is the result of the intricate system of receptors and nervous pathways. There must be then a number of 'colour spaces' from the receptoral level, through the postreceptoral levels, where from one we can arrive at the other using certain rules of transformation. Obviously, these 'colour spaces' will have no one-to-one correspondence to definite colour sensations. The receptoral colour space, for example, is defined by the three cone receptor types, it is a space containing all possible triplet responses, and serves therefore only as the basis of our colour vision (the points of the space do not refer to any type of 'perceived colour' i.e. colour-sensation).

The desired aim is to build a system, which is as consistent in 'judging' (that is, assigning certain 'colours' to objects with certain spectral reflectances) as the eye. In his *experimentum crucis*, Newton 'proved' the composite nature of light and that certain wavelengths and colours can be 'matched'[4]. CO has grown out of this view, according to which a certain wavelength of light has a certain colour. Although, contrary to these so called 'primary colours', light reflected from the surface of objects contain light-rays of differing wavelength, it seems that simply detecting spectral reflectances is sufficient to determine the colour of objects. So the simplest solution for CO seems to be to measure surface reflectance, and from the reflectance curves decide the colour of the object.

But this view doesn't take into account the simple fact, that even if the illumination changes, and with this the surface reflectance of the surfaces, objects more or less maintain their colour. A white sheet of paper looks white both in daylight and in artificial lighting conditions. A white room

[4]See a detailed argument based on Newton's *Correspondence in Sepper* (1988:116-118) that validates the use of inverted commas.

looks white even if it reflects less light than a black room (see GILCHRIST, 1979).

Just as a passing note: if we want to prove that the illumination is different it is enough to make video recordings inside and outside without changing the 'white balance'[5]. This phenomena, called 'colour constancy' means that when calculating the 'colour' of the object the visual system is not measuring the spectral reflectance, but the difference in spectral reflectance of the object and its surroundings. When attempting to model the visual system, colour constancy has to be accounted for[6].

Without going into further details in respect to the actual computations and the problems that have emerged and now seem to be solved, today it is clear (a) that the perceived colour depends on computations that extend throughout the entire visual field, (b) that naturally occurring lights and spectral reflectances do not vary arbitrarily, but can be described in a linear model with a small number of parameters; and (c) that to carry out the necessary calculations to acquire colour constancy the visual scene must be spatially segmented, and in this segmenting colour vision plays an important role. (1995:94)

We have touched upon (a) when talking about colour constancy. The linear models framework theories support claim (b) by stating, that in order to achieve colour constancy there is no need for an infinite number of parameters to be measured. Visual systems can 'cope with' only a small number of receptor types, and so actual lights and reflectances are 'described by representing them as the weighted sums of a small number of illuminant and reflectance basis functions' (1995: 91). And (c) simply put means, that spatial segmentation is needed to decide where one surface begins and where one ends (see also BODEN, 1992). Without this it is hard to imagine how the difference of spectral reflectances can be measured. Of course we could take every point (receptor-field) as an independent entity, but then we fail in one of the most basic features of human colour vision, namely that we see coloured surfaces, not only isolated coloured points.

It would seem that by successfully tackling colour constancy CO could provide a satisfactory computational solution to colour vision. Some results,

[5] Or, we can carry out a very simple investigation that was already known in Goethe's time. By sitting between two different light sources, for example next to a window, when there is a lamp on our other side, and placing a white sheet in front of us with a pencil held perpendicularly to the sheet we will see two shades of the pencil. One will be bluish, the other yellowish. Yet if we close the shutter or switch the light off (or, in this case, put the candles out) the page remains – in both cases – white. (If we have only one source of illumination than the colour of the shadow is grey!) The previously perceived colours disappear.

[6] ET follows Hilbert's opinion: not even difference in spatial reflectance corresponds to difference in colour. Colour is 'objectively subjective'. This attitude is called anthropocentric realism (1995:115-133). It makes a distinction between being coloured (objective) and looking coloured (subjective).

however, seem to limit the applicability of this approach. If spectrally non-selective surfaces seen against a spectrally non-selective background (that is 'grey' on 'grey') it seems achromatic (colourless, that is, again, 'grey') in white light. In chromatic light if the reflectance is near background level both surfaces are seen as grey. But if the intensities are different everything changes: the two 'greys' take on colour! The 'lighter' grey takes on the colour of the illuminant, the darker the complementary. Colour constancy, then, is only approximate! Even if this so called Helson-Judd effect is disposed of by saying that approximate colour constancy is a trade-off of the visual system, a compromise (1995:101), CO still cannot account for is the relation of the two colours: the hue and its complementary. A complementary colour has no intelligent meaning in CO. 'Too many of the mechanisms essential to the production of colour that we see lie within the bodies of perceivers' as Hardin (1990:566) says. If we try to account for complementary colours we have to deal with the 'physique', not only with physics.

3.2. Neurophysiological Subjectivism

A subjectivist approach is not satisfied by the objectivist explanation. It claims that colours are not 'out there', but 'in the head'. This was the view of Schopenhauer, criticised by Goethe, and from this view grew out what now may be called Neurophysiological Subjectivism (NS). It successfully answers the problems of complementary hues, based on studies of the nervous system. Contrary to CO's claim (NS) holds that (a) the notion of object colours 'can be eliminated in favour of the reductive identification of perceptions of objects as coloured with psychophysical and neurophysiological states and processes (eliminativism), and (b) that there are only chromatic visual states and these are to be identified with neural states (neuroscientific reductionism)' (1995:135-36, 205).

By eliminating the objective colour-concept and by reducing colour sensation to neural states that are responsible for this, colour sensation becomes an 'artefact' of the subject, though a very useful artefact. In this case 'colour' must be found in the nervous system, somewhere between the receptors of the eye and the higher cortical areas. Contrary to a computational approach NS stresses the importance of a close study of the nervous system.

That all hues can be mixed using only three basic colours has long been suggested (by PALMER, in 1776; by YOUNG, in 1801). But that trichromacy is based on the fact that there are three types of cone receptors has only been confirmed in the 1960s. Before this several attempts were made to describe colour phenomena (see details in older textbooks, like Hartridge (1950:256-293)). It was also accepted that in human colour perception there are two pairs of opponent hues, colours that cannot be mixed, yellow and blue,

and red and green. These four colours define two axes in the phenomenal colour space. Today, knowing more and more about the postreceptoral mechanisms of the human visual system, this opposition can be explained by the nervous system's build-up, containing 'opponent neurons', responsible for colour contrast.

It would be improper here to go into the details of the neural structure of the visual system. Although many attempts have been made in order to correlate colour- perception and activity of parts of the nervous system, none seem convincing. The activity of V4 (the so called fourth visual cortical area) seems to be closely correlated with the perceiving of colour, in fact with the colours perceived (such as red, green, yellow), and not with the wavelength (for details see DAVIDOFF, 1995). It is, however, unadvisable to claim that we have found the area where colour sensation is (1995:75- 79). The reasons are the following: at present it seems that our visual system is mostly responding to colour contrast (see also BECK, (1975) and WALLACH, (1963)). Also it is possible, that colour and form are not perceived separately ('And why would they be?' is a relevant question from an evolutionary stance.) Lastly, seeking a one-to-one connection between sensation and groups of neurons is a dubious enough practice, not to be accepted without question.

4. Best of Both Worlds, Yet None of Them

ET, though seeing in both CO and NS useful research alternatives, holds that the concept of colour 'as it figures in visual science is inherently double-sided' (1995:215), and argues for a relational approach to colour. From this position he claims that both CO and NS are mistaken when they try to reduce colour-perception to something external or something internal.

Computational Objectivism aims to provide a purely physical, non-perceptual specification to colour. They also want to see proven that the biological function of human colour vision is to detect surface reflectance, and thus arrive at the conclusion that the spectral reflectance (in ET's usage the distal quality space of surface reflectance) determines the perceptual content. They maintain that even though the phenomenal colour space (briefly described above with the opponent structure of yellow-blue and reed-green) might have a structure totally incommensurable to the structure of the distal space yet it does not matter. (1995:186) It is not trivial, however, that the one can be substituted to the other.

ET maintains that colours are (a) relatively stable visual qualities of the world, that (b) have certain distinctive properties, like hue-opponency. In his opinion CO rightly attends (a), but fails in (b), while NS vice versa (1995:139-140). Thompsons view is relational and thus a refutation of both, and his proposed solution is based on an evolutionary account. His claim is

that privileging for the ontology one or the other of the essential poles to colour vision (the physical or the perceptual) makes both positions unacceptable.

ET holds that, as colour vision is most probably of an evolutionary origin, trying to understand the significance of colour-vision without taking this into account we commit a major mistake. In agreeing with him, we also have to agree that although connecting colour with different wavelengths is a very seductive idea, there is absolutely no reason why we should do it, as this connection is unexplained by the Theory of Evolution (1995:113). That this is exactly what CO does (connecting colour with different wavelengths) is a shortcoming of CO, that, at present seems incurable.

Thompson tries to escape from falling into the other extreme with NS, namely to consider colours based on the assumption of subjectivism. This view, as mentioned before, with denying objectivism claims to be eliminativist with respect to colour as a property of objects, by saying that there is no such property as 'being coloured'; and also reductivist with respect to colour experience by claiming that chromatic visual states are to be reductively identified with neural states (1995:135). This eliminativist view is question-begging. If there is no such property as 'being coloured', than the colour of the objects become dependent on illumination. This is contrary to our very basic experience, that the colour of objects tend to be stable.

ET wants to give a framework that is satisfying both (a) colour constancy and (b) hue-opponency.

5. All...Fall Short of the Glory...

5.1. Problems

How do we know that colour vision exists at all outside the human sphere of experience? That is, can we investigate the colour vision of other species? Is it the same as ours? These are very important questions for the ecological view that have to be answered.

Many animals have wavelength-dependent behaviour. An excellent example of this is that certain invertebrates lay their eggs when they are exposed to light of a certain wavelength. There is a difference, however, between wavelength-dependent behaviour and wavelength discrimination, and usually only the latter is taken to be the proof of the existence of colour vision in a certain species.

An animal with one type of receptor can only detect light intensities, that is changing degrees of darkness and lightness. A species with two types of receptors and the necessary neural apparatus can distinguish between two hues; its vision will be two-dimensional, one corresponding to lightness or intensity, the other to the ratio of the two receptor-type's contribution to

the signal. Our vision is based on three types of receptors, and is therefore able to exhibit what we normally call colour vision.

Human colour vision is based on a pair of pairs of colours, on the fact that certain colours (yellow with blue or reed with green) cannot be mixed.[7]

Even if a species has colour-vision, it can be surprisingly different to ours. Some animals have not three but four and may be even five types of receptors. (We call these tetrachromats and pentachromats, respectively.) This means that certain animals, namely some birds and reptiles can have a colour vision of a higher dimensionality than ours. This ET calls a colour hyperspace. The difference between our vision and that of a tetrachromat, according to this theory is similar as the difference between the vision of a dichromat (a colour-blind) and a normal trichromat, like most of us. It means that a tetrachromat can have a novel pair of colours similar to our yellow-blue and red-green pairs.

Why is this enormous difference? Are we a 'normal' or 'typical' species? It seems not. Birds and turtles have very good colour vision. Certain species have oil droplets acting as colour filters in their receptors (like pigeons). Mammals in general have a much inferior colour vision. It is probably a degenerate version of the bird-reptile vision, as the ancestral forms were of nocturnal origin. Only primates are trichromats, as a result of a gene duplication on the X chromosome. As a result of this duplication apart from the original yellow-blue colour axis a novel red-green axis appeared.

Therefore the two pairs of opposite hues are not general in the animal kingdom. In fact, even if we dispose of the many types of colour-blindness (see LAWRENCE, (1987) for example) current results show that some (human) females might be tetrachromats in a strong sense. And a tetrachromat's colour vision is to ours as ours is to a dichromat. That is, they are incommensurable. This shows that even within one species colour vision can differ significantly.

We have to find a more general reason why colour vision, including non-human colour vision is beneficial for the organism, not sticking to human colour vision only. But the perceptual task in general is to (a) detect certain coloured objects, (b) to segment the visual scene, and (c) to identify particular objects or states, also under different lighting conditions (1995:195). ET's argument based on the fact that both CO and NS are modifications of what he calls the received view. In the light of his argument, he claims, both CO and NS fall.

The implicit assumption of CO is that the function of vision is to detect surface reflectance (1995:188), is theory-laden. It is well known that the visual system is selective, and that it is receptive to certain stimuli. Maturana's 'bug-detector in the frog's visual system is an all-too-well known example.

[7]Some question the validity of this statement

The two claims made by the NS[8] are also considered fallacious by ET. He attacks the second more fiercely, by showing that there are incommensurable differences between 'chromatic visual states' and our basic colour terms. His argument is partly based on an 1969 article '*Basic Color Terms: Their Universality and Evolution*' by Bent BERLIN and Paul KAY, (1969) who state that there are 11 basic colour terms or foci, in the over ninety investigated languages.

The logical constitution according to NS would be two pairs of basic colours, namely yellow-blue, and red-green. This is unsupported, and, what's more contradicted by our concepts of colour. There are numerous colour categories that cannot be predicted from neurophysiology alone, like orange, purple, brown, and pink (1995:210). Instead of his many examples (1995:211-214) I will show only one (see also BECK, (1975) and HARDIN (1990)).

Orange and brown are obviously different sets of colours. But looking at their spectral profile we realise that they are the same, only browns are 'blackened' oranges. By looking through a tube at a bar of chocolate in bright light, it ceases to look brown, instead it looks dim yellow or orange (HARDIN, 1990:559). This in itself seems more like an argument against CO. But that in different languages brown is subsumed by black, and in others by yellow (1995:211) cannot be explained by NS[9].

This is unexplained by our knowledge of our neurophysiological build-up. For reasons similar to this, although rightly addressing hue-opponency, NS cannot give a detailed enough answer to the question of the existence of basic colour categories.

6. The Criticism of the Received View – and Two Solutions to One Problem

Since Newton and Locke colour is usually not considered a fundamental property of things. To say it less vaguely: colours are dispositional and subjective properties, so called 'secondary qualities', contrary to the 'primary qualities', that are not relational. Both Steiner and Thompson claim that this view is deeply linked 'both conceptually and empirically' to the Newtonian conception of colour (1995:3). This 'received view' is the basis of the criticism of both Steiner and Thompson. Let us give a brief outline of the argument.

[8](a) that there is no such property as being coloured (eliminativism, something that already appeared in Schopenhauer) and (b) that there are only chromatic visual states, and these are to be reductively identified with neural states

[9]This argument is based on the lack of our knowledge of the nervous system. There is no reason, why more detailed neurophysiological data would not be available in a matter of years.

Both agree that the distinction between primary and secondary qualities is an artificial one. Their criticism only differs in how they attempt to reach a solution.

7. Et – A Terrestrial Solution

Thompson believes that an ecological argument is better than either NS or CO. His description is a relational one, not accepting the one-sidedness of NS and CO. He holds that what the CO describes as the role of perception, namely that 'vision is the process of discovering from images what is present in the world' is fallacious (1995:178). Vision is not *representing* what is present in the world, but presenting it. The received view (inherent in both CO and NS) considers the organism as a passive object, forgetting that it is also the subject of its own evolution (1995:219). Organisms and their surrounding interact (like bee colour vision and the colour of the flowers). Organisms also determine the relevant signals of their environment, and the significance of these signals depends on the organism. They also alter the external world as they interact with it, changing its pattern, which, in turn will affect the organism as well.

Apart from this relational claim ET also holds that (based on the evolutionary theory and the comparative anatomical results) the relevant object for visual reception probably changes depending on the type of the colour-vision system involved (1995:200). His argument is based on research results that show that colour vision varies considerably throughout the animal world, probably because colour vision 'plays a role in segmenting the visual scene into regions of distinct surfaces and/or objects' (1995:201), and different 'segmenting' is beneficial to organisms.

That his criticism is valid and that it stands – I agree. But before subscribing to his solution let us investigate another argument – that of Rudolf Steiner-s.

8. Steiner's Provocation to 'Healthy' Reason

Steiner's concept of colour and vision was mainly formed and developed during his intense study of Goethe's scientific writings in the years 1889-1896. While editing the four volumes of Goethe's scientific writings, he also wrote three books about Goethean science and Goethe's world-view[10]. The Goethean conception of Nature and Science greatly shaped his own thinking. He was the first – and to my knowledge the only one – to try to build up

[10] *Grundlinien einer Erkenntnistheorie der Goetheschen Weltanschauung* in 1886, *Goethes Weltanschauung* in 1897, *Goethes Naturwissenschaftlichen Schriften, Einleitungen*, between 1883- 1897.

the philosophical system implicit in Goethe's writings. It is true, that Hegel is often considered to be the philosopher of Goethean ideas, but it must be clear that what Hegel tried to do is to shape philosophy to make intelligible Goethe's *Archetype* and *Urphenomenon*. What Steiner tried to do is to create the philosophical system corresponding to Goethe's *Weltanschauung*.

The reception of this system resembles the reception of Goethe's *Farbenlehre*. And as now there is renewed interest in Goethe's scientific endeavours, the interest in Steiner's philosophy probably also deserves some attention.

The argument below is taken from the 4th and 5th Chapters of *Die Philosophie der Freiheit* (1894). It was written while Steiner was still working in Weimar. In many senses this is one of his best attempts to expound his philosophy growing out of Goethe's views. [My *addenda* are in square brackets].

His 'received view' is what he calls the view of 'critical idealism'. He believes that this view is mistaken. It starts from what is given to the 'naïve' conception: the perceived object. Then it proves, that what is given to us as a perception would not exist if we did not have sense organs. If there is no eye: there is no colour [there is surface reflectance, light rays of all different wavelengths, but there is nothing that we can call 'colour']. So in the object we see no colour yet [meaning 'chromatic visual states']. So colour is only born in the interaction of the eye and the object [therefore it can be taken as relational]. But there is no colour [i.e. colour sensation] in the eye, either, as here we only find chemical and physical interactions. Colour is only the result of physiological processes in the brain. But instead of experiencing colour in the brain, we first project it on the object, and that's where we feel we perceive it. We have run a full circle.

But this is what happens. First we see a coloured object. Then we start thinking. If I had no eyes, the object would be colourless. So I cannot claim that colour is inherent in the object. Therefore I start searching for it. I cannot find it in the eye [all I find is receptors, neurones, etc.], and I cannot find in the brain [I find intricate systems of neurons, action potentials instead of 'colour', etc.]. I only find it in the soul, but not connected to the object. So, running a full circle I can only find colour where I have started from, and I believe that 'colour' is a product of my soul, which was thought to be in the outer world by a naïve observer.

Stopping here, everything seems to be in order. But let us look at the whole reasoning again. At the beginning – as a naïve person – I believed that my perceptions are perceptions of something objective – that is what there is without me. But now I realise that these sense-perceptions are simply modifications of my mental states [or, again, 'chromatic visual states']. What seemed objective before, now disappears. But if colours are subjective, as they are mediated by sense-organs, so must be forms – it is only through our senses that we perceive them. And, following this, a table, which I believed to have objective existence, becomes a mere notion. But

then my own perceptory organs, my eye, the nerve-endings in my skin, the visual pathways, and all the processes in my eye and my brain become subjective. If my first reasoning is correct, and we use the same reasoning for the parts of our process of cognizing, we arrive at a confusing web of concepts. There is no reason to talk about causal relationships between these concepts. I cannot say that my concept of an object effects my concept of the eye and that in this interaction my 'colour' concept emerges.

The absurdity of this argument is visible as soon as we realize that even about our perceptions and our organs of perceiving we can only gain knowledge through perceptions. It is true, that I have no perception without an organ that perceives. But it is just as true, that without perception there is no perceiving organ. We perceive the colour of an object. And we also perceive the processes in the eye. But these two don't resemble each other in any way. [When talking about the significance of the discovery of a mutation in a visual pigment Thompson cites MOLLON (1995:166): 'Here is a case where a difference of a single nucleotide places people in different phenomenal worlds and where we know almost all the steps in the causal change from gene to molecule to neural signals; *only the final steps from cortical activity to sensation elude us*'. This step is exactly what Steiner objects, and finds impossible.] I cannot negate my sense-perception by showing what processes take place *while* I have the colour-experience.

Can the 'objective' and the 'subjective' ever meet? Critical idealism [the received view in modern science still resembles this view] makes a mistake when it differentiates between sense-experiences. One it takes to be conceptual, but uses the other in exactly the same way as naïve realism used it, the very view that it wanted to falsify. Critical idealism can thus only be proven by being a naïve realist in certain areas, and negating the results of naïve realism in other areas.

But it would be just as fallacious to accept that the 'world is my idea'[11], because if my sense-perceptions of the world are taken to be subjective, than so are my sense- perceptions of my senses, my 'subject'. This mistake, when seen in this light turns out to be rooted in the same mistake as the first one.

9. An Eye for an Eye

The two criticisms agree in finding the received view fallacious. ET's 'ecological' view is naturalistic, not purely conceptual and a priori (1995:216) as the received view, underlying both CO and NS. The 'subjective' attitude to colour is also based on the received view according to both Thompson and Steiner.

But in the light of Steiner's critique the naturalistic view itself is based on conceptual or a priori statements. I hope to show that Steiner's solution

[11] This is how Shopenhauer begins his '*Die Welt als Wille und Vorstellung*'

takes one step back and contains less a priori elements. Clearly by stating that his view is 'ecological'[12], ET stresses the importance of adaptive and co-evolutionary mechanisms.

And what is wrong with that? – one might ask. The problem is that with the 'ecological' view ET remains within a framework affected by Neo-Darwinism, which, no doubt, takes the organism more as a living, interacting being than ET's received view, yet it is still within the 'received view' in many respects.

Neo-Darwinism's indebtedness to Darwin cannot be overemphasised. And as Darwin never questioned the validity of the Newtonian approach to phenomena, it raises the question, as to how one can escape from the 'received view', by following a research program, that took its origins from the same view. The questions that Darwin faced, when trying to understand the 'origin of species', are questions already in the problem-space of the received view. They are, by far, not obvious in, for example, a Goethean world-view[13].

Polányi in his *Personal Knowledge* described two criticisms of the Newtonian concept of space as absolute rest. The difference of Thompson's argument and that of Steiner's reminds one of this incident. The two scientists were Ernst Mach and Albert Einstein. Mach 'prefigured the great theoretic vision of Einstein' (1973:12), that is gave a criticism of the Newtonian concept, that showed its incoherence. It was then Einstein, who proved that Newton's conception of space is not meaningless, but false. Mach was a forerunner of Einstein, and it is interesting, that even though Einstein surpassed him in his insight, he still wanted to follow the positivist programme supported by Mach.

The case is different with Thompson and Steiner. Steiner was the forerunner, and, to my belief his criticism is far more explicit, to the point, and I dare say correct than that of Thompson. And although Einstein 'built on' Mach and surpassed him, thus breaking out of the Newtonian Universe, Thompson builds on the Goethean view[14] but remains in the received

[12]The 'ecological' view is naturalistic, phenomenological: 'the role neuronal processes play is revealed by neuroethology rather than neurophysiology per se' (1995:217); and it considers the animal, together with its environment (*Umwelt*) as a part of a larger creature: the environmental ecosystem. (1995:216- 220)

[13]It is very interesting, and deserves more attention to understand how Goethe's notion of the *Typus* or *Archetype* was corrupted as it travelled through the Channel, and how Darwin misunderstands its real significance in Chapter 13 of the Origin of Species. Also see more about an alternative approach to questions of origin in Lenoir (1982). The Kant-Blumenbach tradition (one, that is in many cases parallel to Goethe's approach) gave fundamentally different answers to the same questions.

[14]In his criticism of the received view ET heavily relies on SEPPER, (1988), and Westphal, both deeply 'involved' in attempts to understand Goethean science. Sepper wrote both his PhD thesis and his first, influential book on the Goethe-Newton controversy, and Westphal also wrote articles in the topic (see '*Whiteness*' in: *Goethe and the Sciences:*

(Newtonian) view. His breakthrough is like the breakthroughs of Stephan Jay-Gould, or Daniel C. Dennett according to some critics; a breakthrough in the 'belt' of a research program, but carefully not touching its 'core'.

10. Despotic Pluralism?

Finally then, what are we to think of Goethe's criticism of Schopenhauer? Is it the stubborn reply of a dogmatic old man? Or does Goethe sense the same mistake in Schopenhauer as he sensed in the Newtonian theory of white light? Schopenhauer was the first in colour science to fully accept Kant's views, and make a sharp distinction between sensation and stimulus (MAGNUS 1902:195). He once wrote about Goethe in 1814:

> 'This Goethe was so much of a realist, he simply did not want to understand that objects as such are present only as far as they are portrayed by the cognizing subject What? He said while looking at me with his Jove-like eyes, the light only exists if you see it? No! You wouldn't exist if the light didn't see you.'

The gap seems impassable. What Steiner and Goethe are saying is hardly comprehensible for someone 'trained' in the received view. I believe that Goethe's rejection of Schopenhauer's 'subjective' approach is not that of a stubborn old man, but is based on his insight, that Schopenhauer's attempt to escape the trap of the 'received view' is in vain. His attitude is not despotic, but based on the firm belief that in order to escape despotism one has to condemn research programs that try to simplify and monopolize the problem of colour. The problem is not with simplification, as it is a more than useful tool, but that our thought-structures quickly gain priority over experience, which gave rise to them in the first place. In his *Maximen und Reflexionen*, No. 1222 Goethe writes:

> 'Hypotheses are the scaffolding which is set up before the building itself and which is dismantled when the building is completed. They are indispensable to the worker; but he must on no account mistake the scaffolding for the building itself.'

'Scaffoldings', then, are useful. What's more, indispensable. But the 'received view' goes further than this: it stands between our first-hand experience and reality. This is probably nowhere as visible as in colour science. If Steiner's and Thompson's criticism is valid, then the 'critical idealism' is

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a Reappraisal, 1987. BSPS 97. Boston.) Goethe also had an effect on many others, like Wittgenstein (*Remarks on Colour*) and most of the Continential Philosophers, Phenomenological Movement, etc.

a thought-structure that is not built on stable ground. And, therefore, if Goethe attacked Newton justifiably, than his attack on Schopenhauer is just as valid.

Thompson wants to escape from the 'received view' by setting a new research program. One, that might give rise to another set of useful answers to intriguing problems. He is right in his criticism, and he gives us a useful tool to investigate colour phenomena. But he does not give us back 'colour'. He simply builds a picture, where the emergence of colour 'makes sense'. It is, just like evolutionary theory explains that what is, could have developed. It gives an answer to the question 'how'. But, similarly to evolutionary theory it cannot answer the question 'what'. In evolution the emergence of species is now more or less understood. But this is not the same as understanding the individual *form*, as it is given to the senses. The same applies to colour.

Steiner's criticism shows this. And in showing that parts of what we thought were the building are only a parts of the scaffolding, his criticism is very useful. It does not, however, directly yield in a new approach to colour. Thompson gives us a new, and probably useful tool, while Steiner gives us a good manual about how to use these tools and how not to. Both are useful, and hopefully direct the study of colours towards a Goethean aim: a pluralism of mutually fruitful and coexisting views.

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