

Movements

Philosophical Aspects of ANPA 23

Arleta D. Ford, *Editor*

Proceedings of the 23rd Annual International Meeting of the

Alternative Natural Philosophy Association

**Wesley House, Jesus Lane, Cambridge
August 2001**

*Published by ANPA
c/o Arleta D. Ford
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Birkbeck College, Malet St, London WC1E 7HX.*

July 2002

Implications: Philosophical Aspects of ANPA 23

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ISBN 0 9526215 7 6

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c/o Arleta D. Ford
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ON MOVEMENT

You might have noticed that there is no overarching title to the Aspect Proceedings. It is not an oversight. It is all because of moving houses. Even iMac is under stress. It developed a hayfever (nothing strange though at this season of year), it sneezes, cannot sleep, and tries constantly to be on line. Technical help advised me that it might have fallen in love with a new flat screen sunflower iMac_ess and wants to gaze at it all the time.

Indeed, moving houses rates as one of the most stressful experiences. Now I know why. It is not really looking for a new flat which is the main problem. One does look for it for about one week at the end of which one undergoes the first major psychological breakdown. One still tries for the second week, at the end of which there comes a total psychological breakdown. One's GP puts one on the waiting list of a neurologist. The appointment is given for 4th October 2003. At least this is something to look forward to. As neurologists go they send you to do an MRI scan, and it is nice to have all one's spins in one direction for a while. It is perhaps the only way to achieve some kind of harmony in one's inner life. Unless you prefer to move up and down in an equilateral triangle (see Mike paper). After two weeks you don't look for a flat any more. You just wait quietly, nourishing your fragile sanity. You know that flats are not to be found. You wait for the universe to issue a miracle. You do pray and ask your friends to pray. The miracle happens.

The real problem however, comes only now. It is a topo-logical problem with packing. As you perhaps already suspect, the laws of physics break down, especially the law of conservation of mass. Unpacked stuff becomes

larger when packed. Indeed, there appears to be something wrong with the very concept of space, as several people in this volume notice. We need a new theory of space which is more elastic and moving friendly. Never mind its continuity or discreteness.

In this context I want to call your attention to Dan Kurth's paper. He discusses 'ontological adjustment' which I need so badly while packing; even more important however is his anti-anti-realism with intuitionistic negation. My logic books are already packed so I cannot check if my memory is accurate and if the anti-anti-realism is less or more than realism. If it is less than realism then if I unpacked packed stuff and then packed it again I would have less of it. I will do an experiment in a minute.

Otherwise, Dan writes his remarkable paper using numbered thoughts. The origin of this form of writing is usually attributed to Wittgenstein. He had 525 numbered thoughts in *Tractatus* and 693 in *Philosophical Investigations*, which gives a stunning number of 1218 thoughts in total. By comparison I had only three thoughts worth numbering in my life, and I remember only two of them. Dan is somewhere in between with his 161 numbered thoughts. Now, I don't know who is supposed to do the ontological adjustment. Philosophers wouldn't, they are not concerned (see Ted's paper). The good news however is that computer scientists might be up to the task. Owen Maroney told me that the Grid computer people do ontologies, and C++ folk do "Non-intrusive object introspection". We should rent their services then.

Coming back to numbered thoughts, if you look at Dan's paper you may notice that the method of numbering is not only that pertaining to Wittgenstein and the Bible but also it looks that the numbers constitute a poset, which leads straight to quantum gravity via the incidence algebra and coarse grained topologies. The coarse grained topology would be quite handy if it accommodates mini black holes in its grains. This would be the called for ontological adjustment. Using the nonintrusive object introspection, the mini black holes would suck in some of the stuff packed or unpacked regardless. I would not need then 10 extra moving boxes. But life is never as one wishes it to be (see Ted's paper).

Sometimes, especially recently, I come to the conclusion that it is best to move out of this reality altogether. Doug Matzke's paper seems to support it. He proposes to extend Information Paradigm to accommodate the subjective I. Indeed, it is less stressful and cheaper to live on the Internet. People are born, live, and die on the net quite comfortably nowadays; they marry and divorce there as well, and do other things that are normally attributed to real life. Descartes' dictum should be modified into *connectio ergo sum*. (Surely, if you don't have a web page, for all practical purposes you don't exist.) Everything has got a web address. I saw a toilet in Finsbury Park, it had a URL on it which began with WWC... This obviously leads to further philosophical problems; if everything has got a URL, would it be a denumerable or nondenumerable number of them? What about the Kochen-Specker theorem for information spaces? (see Clive's paper for clarification). Moving would be a dream on the net, they

calculated that everything is removed from everything else on average 18 clicks only. I have to reconsider which of the TWO realities is more convenient to live in. (This is another factor two which is sadly missing from Peter's paper.)⁴

I met a mouse at 3am in the bathroom. For some time I felt I am not living in my flat alone. It was nice of it to reveal itself on my last day here. We had a small exchange in Latin. It said: *nisi cogito none sum*, and I replied: *nisi connectio non sum*. We parted in peace though ontologically puzzled...

Arleta D. Ford, July 2002

THOUGHTS ON THE CONTINUUM AND THE CH

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In the early days of the Combinatorial Hierarchy (CH) it was often asked: this is all over the field \mathbf{Z}_2 with 2 elements. How will you ever get to the real numbers, \mathbf{R} ? To this technical question the answer was usually: some sort of averaging (to be found in the future) would build up to the rationals (\mathbf{Q}) and \mathbf{Q} is "much the same as \mathbf{R} ". When the CH was reformulated as a process theory the true question was seen to be: given that the scale-constants are logically prior, how does the theory understand ordinary measurements? So that is a philosophical question and (still) needs a philosophical answer. I am concerned with the original technical question and I want to launch a two-pronged attack on the answer.

FIRST PRONG. Given the discrete nature of any version of the CH, & so of whatever added theory which will relate it to ordinary measurement, \mathbf{Q} seems to be certain to be the resulting field. My first prong attacks the commonsense view, also surprisingly taken by Russell (1937), that there is no perceptible difference between \mathbf{Q} and \mathbf{R} . Since \mathbf{Q} is enumerable and \mathbf{R} is not, this view is equivalent to enumerability not being perceptible. A surprising counter-example has come up recently (Meyer 1999) over

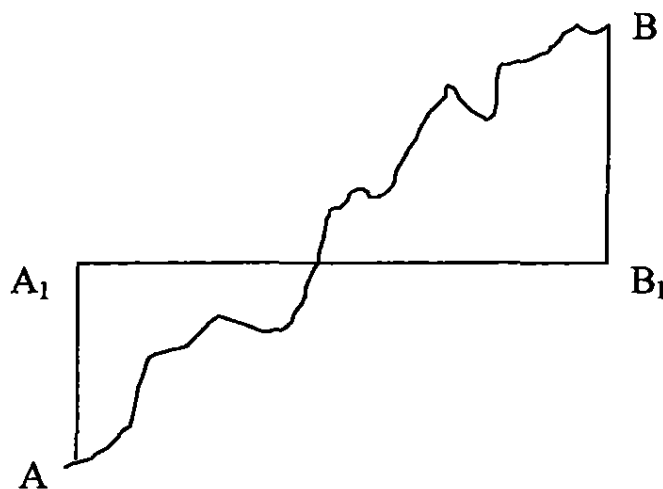
hidden variable discussions in quantum mechanics. In such discussions an important result is the Kocher-Specker theorem. Without going into the subtle details this relates to giving yes-no answers to questions about quantum states. In a two-dimensional Hilbert space every vector has a unique orthogonal vector so it is easy to allot yes or no to all vectors subject to the obvious requirement that if a state has "yes" its orthogonal state has "no". The Kocher-Specker theorem says this is not possible for dimension greater than 2. Consider, then, three-dimensional Hilbert space over \mathbf{R} for which this allotment is impossible. What Meyer showed was that if all this is over \mathbf{Q} then it becomes possible. That is, for every orthogonal triad one vector is "yes" and the other two "no". The reason Meyer can prove this is simply the enumerability; he very cleverly gives a constructive method, a rule, for doing it.

So quantum mechanics over \mathbf{Q} is not indistinguishable from quantum mechanics over \mathbf{R} ; and one might want to push this a little further by pointing out that actual measurements are always over \mathbf{Q} . Perhaps then \mathbf{R} is a step too far.

SECOND PRONG. But, some may say, whatever may be right for quantum mechanics, and it is not all that clear how to replace calculus if \mathbf{Q} is to be used, \mathbf{R} is needed for our everyday perception of space and time. My second prong argues that \mathbf{R} is in fact inadequate for this. I derive this from Hermann Weyl's argument (1917) in *The Continuum*. This lovely book is an attack on the foundations of analysis and is to some extent dated. Weyl has been viewed as a less extreme version of Brouwer but in fact Brouwer is not mentioned in the book which rather leans on Husserl. Weyl's attack is on what he sees as a vicious circle in the late nineteenth reconstruction

of analysis. Essentially this circle is in the founding of arithmetic on set theory, where the concepts of set theory depend “on a prior intuition of iteration and of the sequence of natural numbers”. As he puts it, “the continuity given to us immediately by intuition - (in-the flow of time or in motion) has yet to be grasped mathematically... More or less arbitrarily axiomatised systems...cannot further help us here. We must try to attain a solution which is based on objective insight.”

I think we can take Weyl's argument apart into two parts, one tied to his particular criticism of analysis (which does not concern me here) and one which does concern me. His criticism of analysis can be oversimplified into: admitting unrestricted applications of existence and universal quantifiers for natural numbers but not for sequences of natural numbers. But the other criticism (oversimplifying again) is essentially one which many of us must have worried about in our youth and been bludgeoned by our teachers to ignore. For example, the definition of a continuous function, which we felt ought to capture the way a piece of string stretches from A to B, is paraphrased to an infinite set of definitions involving epsilon and delta, one for each point of the segment $A_1 B_1$.



"In confronting these questions we cannot avoid the concept of set..., no matter how we twist and turn; and the scope of this concept depends on principles of definition!... So the theoretical clarification of time's continuous flow is not forthcoming." Again: "The view of a flow consisting of points and, therefore also dissolving into points, turns out to be false."

Here Weyl is touching on a distinction made by Aristotle in the *Physics* between the "infinite by addition" and the "infinite by division". I used to read this as the distinction between \mathbf{Q} and \mathbf{R} and certainly the infinite by addition is \mathbf{Q} . But the other may well be Weyl's continuum, not \mathbf{R} . Notice, too, that Weyl's criticism is somewhat more subtle than Brouwer's contention that "formalist mathematics cannot construct the continuum". Brouwer is simply pointing out that the number of points actually constructed up to now is finite and so, going on from now, is enumerably infinite. Weyl is accepting \mathbf{R} and going on from there.

Poincaré had anticipated Weyl's criticism: "The continuum as thus conceived is nothing but a collection of individuals arranged in a certain order, infinite in number it is true, but external to each other. This is not the ordinary conception ...in which the point is not prior to the line but the line to the point. Of the famous formula: the continuum is unity in multiplicity, the multiplicity alone subsists, the unity has disappeared."

So my conclusion is this: the road from the CH to ordinary measurement should be directed to \mathbf{Q} (as Pierre Noyes and Lou Kauffman have emphasised). And the discrepancy between that and conventional physics needs to be bridged by a reconstruction of a form of calculus over \mathbf{Q}

(perhaps on the lines shown by David McGoveran). In this one may, on the other hand, dodge anything too radical by the old trick of introducing virtual elements (rather as the nineteenth century geometers introduced points at infinity). That is, one simply allows the extension of the rationals by virtual elements corresponding to Dedekind cuts but insists that one's ontology does not include these virtual elements (misleadingly called 'real numbers' by the mathematicians). They must remain nothing but helps in calculation. It would be a straightforward if tedious task to determine whether this is possible or whether some unexpected trouble lurks. As for the continuum, I agree with Weyl and Poincare and this marks an amicable philosophical divorce between me and Alison Watson, who has for many years protested the absolute continuity of her theory to my deaf ears. I now see how right she was.

REFERENCES

Meyer, A. 1999. *Phys Rev Letters* 83, 3751-4.

Russell, B. 1937. *The Principles of Mathematics* (2nd edition), London: George Allen & Unwin.

Weyl, H. 1917. *Das Kontinuum*, Zurich. Translated as *The Continuum* by S.Pollard & T.Bole, Dover, New York, 1994.

ON PHILOSOPHY AND COMMONSENSE AT ANPA

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It was warming, directly after ANPA 2001, to find people tossing ideas about for the next year

One question that repeatedly arose then and in 2002 was whether we were being philosophical enough. I assumed that many matters that we discussed had far-reaching philosophical implications; yet perhaps these were not made explicit enough. For example, the name of Kant was mentioned a few times, but, for all our concern with the discrete, we did not hear of the *Ars Combinatoria* of Leibniz. Much less did we hear of the monadology, though when I think about the quantum it is the metaphysics of the monad rather than the metaphysics of the sense datum that seems to lead somewhere.

At our meeting someone suggested we delve into and confess our visceral reactions to the idea of the continuum. In a like spirit I confess to the need for a full-ranging and flexible metaphysical enquiry into the true origins of the quantum, and have always found the prevailing fixation with modern empirical philosophy stultifying. And OH how boring! Was there not more to it all than that? as a student I used to cry.

The fundamental discoveries of the last century seemed to offer clues to an enlarged vision. However the clues have failed to promote an appropriate metaphysics because we seem stuck with “commonsense” supplemented by Newtonian mechanics. We failed to react to these clues because we cannot extrapolate its “commonsense” picture to the new fields but seem only to be able to put patches over the gaps using the same material as that whose universality is in question.

My proposal for a solution will not surprise anyone: a combinatorial approach will cause us to confront the metaphysical puzzles about the nature of the particle about which Newton famously said he would make no hypotheses. However people at ANPA will feel that that something fresh is needed which will do more do than bang on about the combinatorial hierarchy, and I think I see a more general argument which might be useful as something of a framework for the more philosophical part of our discussions next year.

We talk a lot about discreteness as opposed to the continuum, yet in the vital early stages of our thinking we temporize with the continuum. We have not faced up to what a discrete approach involves. It is often said that at some small distance we cease to be able apply the ordinary notion of length. The logical error in this pervasive kind of remark will be more palpable if we rephrase it “..at some small distance we cease to be able to apply the notion of distance”. Other approaches to fundamental dynamics all seem to be vitiated by the same gap in explanation. Complementarity, now out of favour, put the philosophy in the centre whereas, for example, string theory might as well make up the world using little steam engines,

so irreducibly classical is it. Where has the philosophy gone? We should be in as good a position as any to find an answer.

The 'commonsense' of classical mechanics is what we use to give meaning to all our formalism and equations because we imagine everything using the *definitions* of the classical dynamical concepts such as charge, mass, spin with the definitions of them in terms of the motions of little balls with which we grew up. Therefore if we would abjure slavery to commonsense then we face the task of defining these concepts - charge, mass, spin and all the rest - purely combinatorially, and leaving till later the task of showing that *in certain circumstances* these definitions will amount to the same thing as the little balls.

To take the weight off endless going on and on about the hierarchy I have attempted to separate the philosophical innovations which I see to be required for the hierarchy approach so that they could be put forward in their own right to be fulfilled perhaps in other ways and anyway discussed separately.

By "Commonsense" I mean roughly "everything being reducible to motions of particles in space". Perhaps we can say 'spatially defined elementary entity' for 'particle'. In current physics the dynamical concepts (for example energy, spin, momentum) are all defined in terms of the spatial motions of these entities, and in spite of the protestations that people frequently make, all physicists carry on their imaginings using pictures which incorporate these definitions, *and nothing else*. It is a most exciting project to rebuild each of these dynamical concepts combinatorially.

Relativity and quantum physics have long been taken to show that the space framework is not of universal applicability, so the presumption that intuitive spatial relationships are the inevitable starting point for all physics has to be called into question. If it is sometimes not applicable, ought we not to start with the assumption that it *never* is, until we have replaced the simple-minded intuition with something explicit.

So let us remove the space framework: what have we then? (We should remove time as well, if that is seen as a physical continuum, though we probably cannot remove succession). We have changes (permutations or whatever) going on, and we mostly use group theory to act as a sort of engine to keep the changes going on. Of course it is up to a would-be theory to specify everything in terms of general principles, and there will necessarily be simple elements. Particles will not in general be the simple elements because to be dignified by the name particle they will need some sort of stability against disturbances (perhaps disturbances we shall have to represent, *faut de mieux*, as random).

We find something of this in high energy physics, with one vital difference. Questioned on the mathematical structures they use, the HE physicists appeal back to groups which have a spatial or spatio-temporal interpretation. Of course that is no good to us.

It may look as though I am embarking on a super-abstract picture. Not bloody likely. True we are not talking of pushes and pulls now, but the formulation we need is just as down-to-earth and engineering. We need to be able to say what the particles are and what the bits do to cause them to act as they do. Of course we expect to use the insights of quantum physics

(things like 'exchange') but only so far as they are not contaminated with continuum thought.

These views mean that we need a philosophy which promotes investigation of the origins of atomicity and pictures of the elementary constituents of the universe. We have to get behind commonsense as some philosophers have tried to do in the past. Pope wants to impose a philosophical Verbot on any such thing - and have it branded a total error. At least if he were right he would be giving a rationale to the behaviour of some physicists.

There seems a rubicon to cross before ideas of extended space appear. Etter has made a profound point of the distinction between 'composition' and 'extension'. The rubicon crossing is the step from one to the other. Kauffman analyses what is involved in taking this STEP.

I think that if anyone knows of suitable philosophers they should try to bring them in. I was in Cambridge recently and talked to Peter Lipton of Hist. and Phil. Sci. His best effort to think of philosophers was Jeremy Butterfield. Anyone who wants to can contact him but I don't think he tackles the conceptual failures of quantum theory, but sticks to exegesis of quantum theory texts. Peter invited me onto their discussion website to contact any of our way of thinking. I hope there might be young people there who would respond to the prospect of some full-blooded philosophy. That might be a good idea before ANPA but I haven't got round to it. He invited me to their seminar but I found it depressingly unchanged since 1960. They seem fixated on 'verification', and to think that their aim should be to get an aseptic account of verification as a universal automatically applicable technique. For them, any reference to actual physical problems shows failure.

I shot my mouth off, above, about string theory. Indeed I do not know much about it. I have the idea that they think that because they know how to use the idea of a dimension when there are three of them they know its meaning when there are eleven and a half of them. If I am wrong could someone enlighten me please. All hell is let loose over the meaning of the concept even when we get to four. Again where has the philosophy gone? The conventional observer philosophy is flawed, but that means one has to try harder, not to withdraw from the struggle and talk naïve realism.

**ACTUAL EXISTENCE AND FACTUAL
OBJECTIVATION**

OR: anti-anti-realism with intuitionist negation

*OR: why veracious objectivism with ontological adjustment can
do better than epistemologically infected would-be ontologies*

OR: what theories are and what they are not

OR: why in the course of the matter truth will come to light

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Reprint of an article presented to anpa-list on May 15th 2002

(<http://groups.yahoo.com/group/anpa-list>)

*Then we entered the Straits in great fear of
mind, for on the one hand was Scylla, and
on the other dread Charybdis kept sucking
up the salt water.¹*

PRELIMINARY PRELIMINARIES

There is a certain unfair asymmetry in the world: anti-realists make some good points by attacking epistemological realism², because there they have a good point. Realists make far less good points by defending realism, because there they have no good point.

To make this very clear from the beginning this paper is not at all and in no instance whatsoever in the business of epistemology, some people might feel that it is sometimes somehow *about* epistemology which then might be due to their perceptions. But anyway being about something doesn't mean being in the business of that something.³ Realism and (some

¹ Homer, *The Odyssey*, book XII, (transl. by Samuel Butler),
http://classics.mit.edu/Homer/Odyssey_12.xii.html

² Epistemological realism as usually opposed to anti-realism is in principle quite a different thing than ontological realism as opposed to idealism, notwithstanding the fact that these both kinds of realism frequently go together. If from now on we speak of 'realism' we will always speak of epistemological realism if not explicitly the contrary is announced.

³ For example there are probably hundreds of tutorial textbooks about epistemology the authors of which do not stand for any specific epistemological position, at least not in

sorts of) anti-realism are rightly seen as representing predominantly epistemological convictions apparently being opposed to each other. But then this opposition is essentially based on a very common ground or rather the very common fault of them both as will be shown in this paper. In the course of this paper we will introduce anti-anti-realism (with intuitionist negation) and whatever this might turn out to be it will definitely not turn out to be an epistemological position. The notion of 'anti-anti-realism with intuitionist negation' anyway is already by itself a paraphrase of (implicitly) proposing that realism and anti-realism show some equivalence under a certain aspect and that anti-anti-realism with intuitionist negation does not so.⁴ We are hopeful that in the course of the paper that aspect will come to light.

Thus a way to correct that certain unfair asymmetry might go as follows: anti-anti-realists should eventually start to attack anti-realism - from maybe unexpected directions and surely with a very unconventional strategy - because there they might have some good points to gain. And anti-realists then should start defending anti-realism (maybe after first having sorted out which one they lately prefer). Afterwards let's count the points or rather - the fallen.

these textbooks. Of course such textbooks are only a very few of a legion of examples which corroborate that proposed distinction of 'being about something' and 'being in the business of something' as another graphic example may serve that there are quite a lot of today's books and papers which are about the historical controversy between the Ptolemaic and the Copernican system, yet the authors of those books or papers really only rarely turn out to take a side or to be proponents of one of the both positions, i.e. they write *about* that historical controversy but they are *not in the business* of that controversy.

⁴ That of course will be apparent to people somewhat familiar with intuitionist logic.

1. AS A FURTHER PRELIMINARY: INTRODUCING ACTUALISM

1.1 We understand the term ‘actualism’ as a shortcut for the following proposition: The actually existing world is made of actually existing entities and the actually existing interactions between them.⁵

1.1.1 For a better understanding of 1.1 one should note that ‘interaction’ here is not meant to be a theoretical or scientific term in any possible sense or to presuppose or to imply any objective (theoretical or scientific) knowledge. ‘Interaction’ instead has to be understood as something alike the ‘contact between an actually existing person and other actually existing persons or other actually existing things’. Therefore there is some overlapping of the meaning of ‘actually existing world’ with the meanings of ‘Lebenswelt’ (as introduced by Husserl) or ‘In-der-Welt-Sein’ (as introduced by Heidegger). Yet the scope of ‘actually existing world’ is not confined to the (social)

⁵ To elucidate my understanding of ‘actually existing world’ I will give the following as an illustration:

a) Actual physical existence is effected and warranted by actual physical interaction. In other words: only if an entity actually physically interacts then this entity also exists physically.

b) Therefore the actually existing world should be thought of as the totality of all actually existing entities, i.e. the totality of all actually (directly and indirectly) interacting entities together with the respective actually operating interactions.

But because these both statements a) and b) imply a reference to possible objective knowledge they must not be seen as a part of our preliminary introduction of actualism but only as an illustration - hors concours.

world(s) of human beings or intelligent living beings in general.

1.1.2 As being actually existent also persons (or any observers) - directly or indirectly - do interact with all other actually existing entities (including such they may never have heard of, they don't know anything about and even possibly including such neither they nor anyone else ever had a theory for)

1.2 The actually existing world, i.e. the actual existence of actually existing entities and the actually existing interactions between them, is a *crude given*.⁶

1.2.1 For a better understanding of 1.2 one should note that the actually existing world has strictly to be seen as not related to, not dependent on and not derivable from any objective factual knowledge (about the world), any theories, any science or any epistemological conceptual frames.

1.2.2 Just on the contrary the actually existing world has to be understood as an utmost radically pre-theoretical given as well

⁶ For reasons of readability I would have preferred to say 'a crude fact' instead of 'a crude given' but that would have been inconsistent with what I thoroughly want to make clear here, namely that the assumption of actual existence and the actually existing world in particular is neither dependent on nor in any other way due to reasoning, (learned) knowledge or even theoretical presumptions but that instead it stems from certitude. Thus it is not in any sense *made* (for example by means of our intellectual capacity) but instead it is given (for example as a precondition for our being as such as well as for any possible intellectual capacity of ours). Therefore it shouldn't be referred to as 'fact'.

as an extra-theoretical precondition for any possible existence of any objective knowledge (about the world), any theories, any science or even any epistemological conceptual frames.

1.2.3 Thus actual existence is utterly not in the scope and not an object of theoretically based factual knowledge.

1.2.3.1 Therefore it is nothing but missing the point to ask someone: "But how do you know about the actual existence of the actually existing world?", because there is no question of knowing but a question of living (or subjectively existing).

1.3 Actualism as introduced here in the foregoing has no epistemological significance whatsoever.

1.3.1 Therefore actualism as such doesn't provide any means to refuse either realism or anti-realism at large. Agreeing to it could make any reasonable ordinary anti-realists at the most feel a bit uncomfortable, but it wouldn't mean any imminent threat to their position.

1.3.2 Not agreeing to actualism would obviously be the choice for some - perhaps less reasonable but as a compensation for that maybe more suspicious - anti-realists, in particular the solipsist breed. And by doing so they would not have to fear any inconsistency of their position so far.

- 1.4 To make this as clear as possible once more: no anti-realist of whatever kind has to agree to or admit any of the previous propositions, i.e. till now we didn't start with an argument but simply tried - as a preliminary - to somewhat clarify our terminology and put some of our basic convictions on the table. Sooner or later we would have to do so anyway and there is no reason why not to do so at the beginning.

2. STARTING THE ARGUMENT: ACTUALIST EXISTENTIALISM⁷

- 2.1 Your actual subjective existence is not an attribute, a property or an adjunct to yourself, yet your actual existence is just your actual existence. As such it is a radical presupposition or rather a radical given for having any attributes, properties or any adjuncts whatsoever.
- 2.1.1 You can not have or hold your actual subjective existence as you can have inner states like pain or hold beliefs, convictions or propositions.

⁷ Our argumentation in this section of this paper (as well as the terminological introduction of actualism in the previous one) must not be seen as an end in itself. But it is in its uncompromising setting also meant to do as a preparation to prevent a seemingly obvious (mis)understanding of what we will say in the 4th and in particular the 5th section, namely the misunderstanding that we then would propose an idealist view. Emphasizing certain aspects of theories easily tempts to commit a metabasis namely to feel somehow entitled then to forget about the *primogeniture* of actual existence. We shall not be tempted to commit such a metabasis.

- 2.2 You don't need a theory for your actual subjective existence, i.e. therefore that you (can or) do actually exist.
- 2.3 Your fundamental existential apprehension of your actual subjective existence is neither derivable from nor - in principle - dependent on theories, but it is founded in *your certitude* of actually being existent.⁸

⁸ But it is a sad fact which can be concluded from an awful lot of philosophical writings - including such written by as prominent authors as Descartes, Berkeley and Fichte - that very many philosophers at least when considering their topics under the influence of epistemological obsessions simply lacked the sanity of having such certitude. This didn't take a turn for the better when it later under the flags of hermeneutics, theory loadeness, social construction et. al. became increasingly popular to propose that everything had to be seen as being covered by a set of impenetrable pre-understandings (Vorverständnis) sometimes called 'interpretation'. This might or might not have its place in the humanities which are no topic of this paper. But one would have to expect that the proponents of that stuff would also so intensely lack reason as well as self-respect (I'm not sure in which sequential order) that they wouldn't shy away from uttering such sounds as 'Everything which can be proposed - including the proposition that someone's fundamental existential apprehension or awareness of his actual subjective existence is founded in certitude - has if it is proposed a mental representation so it is a part of someone's mental state or (as a proposition) his cognition and so it is a sort of knowledge and as such inseparably entangled with various pre-understandings.' Such inference would in my view even be in itself, namely its last step, be incorrect (because of an incorrect or at least severely ambiguous notion of knowledge) but that anyway doesn't matter much here. Because fortunately such display of self-multification can already be defeated simply by examples, one of which may be the following: Imagine a child three to four years old living in a community which doesn't hold any proper (i.e. scientific) theories may it be because of social misery or because of belonging to a pre-theoretical culture. Now imagine someone coming to this community carrying with her some food and sweets or other little gifts and then start to give it to the children of that community as presents but deliberately leaving out the one we introduced above and even saying directed to that child or to the other children: 'No, don't hand any presents to that over there, because it doesn't exist.' (Dear readers, please calm down and skip your indignation, I anyway side with you and we will bring that case to UNICEF's attention together!) If she performs that cruel behaviour in a not too discouraging way thereby giving our child a chance to defend the actuality of its existence this one will start to do so may it be with whatever unskilled appeals or by being charming or daring and will be hopefully successful. Thus it will not only have

2.4 Thus you must at first exist to possibly hold (or have⁹) a theory.

2.4.1 Actual subjective existence - as related to theories - is a radically pre-theoretical given as well as an extra-theoretical precondition for any possible existence of theories.

2.5 To make an explicit distinction between on the one hand actualism, which says that there is an actually existing world made of actually existing entities with actually existing interactions between these entities, and on the other hand the set of propositions which are based on the specific assertion that there is plain actual subjective existence we will call the later from now on 'actualist existentialism'.

2.6 Actualist existentialism as outlined above now in a way will allow us to finally neglect solipsism.

2.6.1 Actualist existentialism allows us to do so not primarily by arguing with the proponents of solipsism about their

proven that it has a fundamental existential apprehension of its own existence (founded in certitude) without possibly holding any theory from which this insight could have been derived but also that it has more sanity than all these philosophers together which tried and still try to do it the other way round. (*They* wouldn't get a single candy from me!)

⁹ 'Having' a theory of course is something different as having pain. Even if it sometimes may cause pain to oneself or others (the later being preferable, at least for me).

epistemological conceptions yet instead by regarding the holding of those conceptions to be an existential absurdity.

- 2.6.1.1 The basic assertion of a (radical) solipsist is *that his or her consciousness (or mind or mental state) is the only what exists*. The problem what he or she will get is with the ‘*his or her*’ in that assertion. The reason for this is that we can challenge the solipsist by stating that when he or she is confronted with his or her own actual existence he or she by that then is confronted with a crude given which is not just a matter of his or her imagination or mind. The solipsist now can either agree and by that *begin* to cease to be a solipsist or disagree and claim instead that his or her so-called own actual existence would just *be an imagination or a mental state of him - or herself*.
- 2.6.1.2 But that exactly is something he cannot do. Because such a claim is equivalent to a statement that he as well as his mental states would *not* exist.¹⁰ Despite the fact that this could very well be desirable for other people than that solipsist he still simply wouldn’t be entitled to assert such an existential absurdity apparently based on an implicit logical contradiction.

¹⁰ The reason for this is of course that a mental state cannot exist by itself. Yet there would probably be found proponents for that as well. Even if these proponents could no more be regarded as proper solipsists (because they already would have lost that ‘ipse’ and would perhaps better be called ‘mentesolists’) there also is an argument of the same sort as the previous one available against such people: At least that mental state must somehow exist. And that existence (or at least some existence which would come up in a possible seeming infinite regress) must be something different than just an attribute of the mental state of which it is supposed to be its existence.

2.6.2 Yet this indeed was not all the task to be done. This rather comes up with the question if a less radical solipsist would after having admitted actualist existentialism also have to admit the far more general propositions of proper actualism itself. And this doesn't seem to be the case. That less radical solipsist must not admit actualism. But this is not the (dead) end of the argument and not an easy escape for more or less radical solipsists. *Because the question is not what she must admit or must not admit but what she cannot propose.*

2.6.2.1 For example she cannot deny actualism by saying that she admits her actual subjective existence but at the same time claiming that her actual subjective existence would be the only actual subjective existence which exists and thereby somehow mutate from a solipsist to - so to speak - a holipsist¹¹. A position very similar to that which is frequently thought to be the proper solipsism yet isn't.

A less radical solipsist cannot propose this or any other alternative to actualism because he in any of such cases then would not only cease to be a solipsist but even also cease to be a sceptic because he would have stated to have objective factual knowledge of (the making up of) the world (external to his consciousness).

¹¹ To add insult to injury I have to confess that such a mutation then would seem to me to be a kind of Graeco-Roman style transformation.

- 2.6.3 Therefore the only thing a solipsist confronted by his own actual subjective existence can do is either to admit his actual subjective existence and by that to stay in the discourse or to deny it and then to become a case of existential absurdity. Yet if he admits his own actual subjective existence he cannot propose to have or to be able to have any objective factual knowledge about the external world. Just to the contrary he would have to propose that he has not and cannot have any objective factual knowledge about the external world. And that's exactly what we want him to confess.
- 2.6.4 A reasonable former solipsist would then eventually have transformed to become a sceptic.
- 2.7 As far as scepticism is concerned proponents of this position again have three choices: they can either agree to actualist existentialism as outlined above and then happily live on to be sceptics - at least for a while - or they can refuse actualist existentialism and thereby turn out to have become genuine solipsists and then should not wonder if being treated as such. The most appropriate attitude of a sceptic relating to the question of agreeing to or refusing actualist existentialism of course would be making no decision at all and to remain sceptical instead. But this would be no escape because actually being sceptical about one's own actual existence is not less an existential absurdity as the respective solipsist position and just being as completely meaningless as that.

- 2.8 So we might conclude this in a more traditional manner: Nisi sum non cogito. Or to put this in a more classical Latin and in a one with more notional rigour as the one a particular continental philosopher preferred to apply: Nisi sum existens prius tum ne cogitans ero quidem. (If I do not exist at first I then will not be thinking too.)

3. THE INTERFACE OF THEORIES AND ACTUAL EXISTENCE: EVIDENCE

- 3.1 Theories do not refer to the actually existing world or to any actual existence.
- 3.1.1 The actually existing world is not in the scope of theories.
- 3.1.2 The actually existing world doesn't directly or immediately interact with theories.
- 3.1.2.1 This is of course is just trivial not at last due to the fact that theories do not act at all.
- 3.1.2.2 For a better understanding of 3.1.2 please note: The actually existing world has no direct or immediate significance for theories, except for the fact that theories usually are hold by actually subjectively existent entities, which indeed is an important 'fact' (yet not of theories but of life).

- 3.2 The holders of theories - apparently inspired by that holding - often show a particular attitude towards a presumed relation of theories to the actually existing world, which is: they test them.
- 3.2.1 Yet testing a theory does not at all imply or yield the possibility of gaining any so called empirical (insight or) knowledge about the actually existing world.
- 3.3 Testing a theory is essentially nothing but a sometimes quite complicated way of making a very special betting on the outcomes of predictions possible. The result of such bets itself then is sometimes called 'evidence'.
- 3.3.1 The betting - of what we are speaking here - can be as well a bet between different proponents having opposing expectations concerning the possible outcomes of that testing of a theory as a bet with oneself about the validity of opposing hypotheses one weighs against each other.
- 3.3.2 Evidence is gained by the results of the betting on the outcomes of predictions. There are mainly three kinds of predictions
- a) Predictions of the outcomes of actions possibly combined with events. Such actions combined with events are normally called experiments,
 - b) Another kind of prediction is rather a then still not observed postulate of the theory like for example - at their time - the

existence of the neutrino or the aberration of the mercury orbit have been. The observation of the postulated occurrence (i.e. the corroboration of the respective postulate) then has the same significance as the outcome of a proper experiment and - in a sense - is an experiment (with less action and more event).

c) The third kind are the implicit or rather tacit predictions which underlie as well as diffuse into all the applications of theories, i.e. all applied science and thereon based technology. These latest are the ones with the least philosophical relevance because there the basic validity and significance of the respective theories themselves is hardly ever at stake or disputed, but then these also are the bets by winning which one can really make the money.

3.3.3 The particular predictions as related to actual tests or experiments are not a proper part of the respective theories, that is because theories do not specify individual cases and events but predictions must do.

3.3.4 Yet this is not so obvious in the case b) of 3.3.2 i.e. the one of the mentioned postulates.

3.3.4.1 Even though for example in the case of the aberration of the mercury orbit there *had* been indeed still alternative explanations around (even after that prediction of GR had been confirmed), and the mercury orbit after all is quite an individual case.

3.3.4.2 In such other cases - as the neutrino case is one - this can no longer be reasonably proposed, even though absolutely any observation presupposes an extra-theoretical interpretation requiring specifications and even acts of pointing to something for ascribing that something the property of being an instance of a model of a respective theory. But this is just a further explanation of the fact that theories do not refer. It does not provide the means to play down or lower the significance of such kind of postulates which stem from the very entrails of a theory (in the case of Pauli's prediction of the existence of the neutrino from the role of symmetries in QM) and then become confirmed by observation. Thus we have clearly to admit the fact that in such cases a particular evidence appears to come into very close contact with the adjunctive ontology of the respective theory.

3.3.4.3 But even then presumably actually existing neutrinos are not in any sense more a part or an element of QM (or any other theory) than actually existing electrons, the presumed existence of which had not been postulated by QM but rather been - loosely spoken - a dowry by preceding theoretical models (as e.g. Rutherford's model of the atom), i.e. neither neutrinos nor electrons nor any presumably actually existing entities are proper parts or elements of any theory. Simply because of that stubborn fact that theories are made of propositions or models and not of entities.

3.4 Evidence doesn't consist of or lead to (empirical) knowledge of the actually existing world. Evidence rather contributes positively or (in the case of lost bets or lack of evidence) negatively to the degree of conviction which potential (rational and not too old) holders can muster up for their support of a particular theory.

3.5 *Evidence selects.*

3.5.1 To try to provide a better understanding of that selective function of evidence I will - for a moment - transgress to a seemingly unrelated topic being well aware that by this transgression I will hardly make more friends.

3.5.1.1 Saying that theories do not refer implies - in my view - a very strong analogy to saying that biological species do not adapt. I tend to hold both these propositions for similar reasons. Explaining the reasons for holding the proposition related to evolutionary biology may help (or not) to understand the proposition related to the philosophy of science.

3.5.1.2 Adaptation is an utterly Lamarckian concept (despite the fact that Darwin used it at the core of his work). Adaptation implies and demands a possible minute change and variation of the built-in construction of an organism caused by comparably minute interactions with a so called environment which the organism must be somehow enabled to actively grasp or even screen as such. And then to be effective that minute change and

variation had to be adjusted to a rather invariant structure of the so called environment and not just to the ever varying appearances of it. But for the organism such an invariant structure of the so called environment simply doesn't actually exist. If anything at all would exist in that sense then it would have to be the mentioned ever varying appearances and there strictly would be no adaptation or active assimilation possible to that, because an organism impossibly ever could minutely change or vary its built-in construction in any therefore required way as we know from genetic biology.

3.5.1.3 The environment is rather a black box for the organism. And the changes and transformations which the subsequent organisms are subject to in the course of biological evolution are - so to speak - caused by the unpredictable boons or strikes effected by the unaccountable forces in that black box. 'Adaptation' should - in my view - be regarded as to be nothing than a synonym for 'fine tuned selection', but then selection anyway is always fine tuned (i.e. as fined tuned as necessary to be effective).

3.5.1.4 What adaptation implies and demands, namely minute change and variation of a built-in perceptive construction of an organism, can only be accomplished and performed by a learning system. After all adaptation is an utterly Lamarckian concept.

3.5.2 Now let's see if we could have learned (since at least we should be supposed to be somehow learning systems) anything for the sake of the philosophy of science by that transgression to evolutionary biology?¹²

3.5.2.1 If that proposed analogy holds than the actually existing world should be the same for theories what the environment has been said to be for the organisms, namely a black box. But because that doesn't sound as philosophical speech is supposed to sound, we rather would translate this: For theories the actually existing world is - a sort of - thing in itself.^{13 14}

¹² But then there also a note of caution has to be expressed, especially addressed to those which might admit the significance of the analogy mentioned in 3.5.1.1. Despite this analogy of adaptation (of organisms) and reference (of theories) in respect to the fact that both do not exist, I don't view the development of theories in the history of science bearing any relevant similarity to biological evolution. Just to the contrary: there are overwhelmingly differences between these both kinds of development.

¹³ The sort of this 'thing in itself' at least is one which is neither derived nor presupposed by any epistemological consideration, i.e. it is not of the Kantian sort. To address another aspect of our topic in this section, namely the 'interface' of theories and actual existence, might perhaps help a bit to sort out: In the view of so much windowlessness as we ascribed to theories some people might somehow feel reminded of the monads of Leibniz and perhaps such feeling is not completely misleading.

¹⁴ To carry that proposed analogy between the selection of theories in the course of the history of science and the selection of species in the course of biological evolution to the extreme of a statement analogous to that telling semi-tautology at the core of the theory of natural selection, i.e. the one concerning the 'survival of the fittest' one could state that in the history of science theories become selected by evidence to the result of the 'confirmation of the best-fitting'. Yet as fitness in biological evolution shouldn't imply adaptation but just the ability to survive (at a particular stage of evolution) so 'fitting best' in the philosophy of science shouldn't imply representation but just the ability of a theory to relatively better conceive, elucidate and explicate a theoretical problem or question (at a particular stage of the history of science) than its competitors at that time could do. This could include as well a fitness for successful predictions (or winning bets) as - in particular in somewhat earlier stages of the history of science - a fitness for

- 3.5.3 And evidence (or the lack of it) should be seen as analogous to the unpredictable boons or strikes which - in the case of evidence - now are effected by the unaccountable making of the actually existing world. That these boons or strikes are unpredictable is in no contradiction to the proposition that evidence is gained by the results of the betting on the outcomes of predictions. Because if we would be able to predict these boons or strikes this would mean that we would be able to make a (kind of meta)prediction about the possible success or failure of our original predictions, i.e. we would always win, i.e. we would actually have (total) factual objective knowledge about the entire making of the actually existing world. Which would correspond to an assertion refused in this paper and which - to put it mildly - also doesn't seem to be the case.
- 3.6 Ceterum censeo: For a theory the actually existing world is a black box or a sort of thing in itself.
- 3.7 Evidence doesn't provide either falsification or verification of theories.

withstanding being examined in the light of even completely arbitrary authoritative extra-theoretical dogmas. Of course neither the evidence mustered for the predictions nor the ability to successfully pass (or *survive*) the examinations based on those extra-theoretical dogmas ever had anything to do with the proper internal *truth* of the respective theories. (Cf. the sentences 5.6 to 5.17 in this paper.)

Thus the fitness in both cases (the biological and the one related to the historical development of theories) is a *fitness for* (a qualification, a capability or a state of being enabled) and *not a fitting in, a fitting into, a fitting to or a fitting with* which all are characterized by connotations implicating adaptation or some kind of a possible mapping or representation.

3.7.1 Evidence instead rather increases or diminishes the strength of the adherence to (or the convictions concerning) particular theories, namely the respective strength (of convictions or adherence) which the holder of these theories can muster. Thereby the insufficiency or lack of evidence might sometimes even induce these holders to give up respective theories.

3.7.2 Theories cannot be falsified but instead become either meaningless (as - very generally spoken - for example the phlogiston theory), defunct (as for example the Ptolemaic system) or a restricted if not transmogrified model (often called: a special case) of another theory (as for example the Keplerian theory in relation to the Newtonian or the Newtonian in relation to GR). After having become meaningless or defunct theories then sometimes even have been given up. But even if theories are given up this is not because of falsification yet because of selection which becomes effected by the relative amount of supporting or debilitating evidence which can be gathered or must be admitted by their agents, i.e. their proponents.

3.8 Theories do not *actually* exist.¹⁵

¹⁵ We understand the term 'actually exist' as used in 3.8 in the sense of 'actual existence' as introduced in the foregoing sections of this paper.

- 3.8.1 To spend a little soothing to them which may need it, I am prepared to give a maybe little less shocking *interpretation* of 3.8: Theories strictly are no elements of the Lebenswelt.
- 3.8.2 It is - to say the very least - reasonable to assume that manuscripts, textbooks, CD-ROMs, writings, sentences, formulas, graphics, illustrations as well as lessons, acoustic occurrences in universities, demonstrations and experiments do exist. Yet theories do not actually exist.
- 3.8.3 Theories cannot interact, therefore theories cannot actually exist. This seems to lead us to the rather unpleasant conclusion that there are 'somethings' which do not actually exist, an assumption which frequently can be found having close ties with weird ideas. To somewhat avoid such unwelcome alliances we say that theories exists not *actually* yet merely *intelligibly*¹⁶, but we agree that such terminological subtlety alone doesn't effectively fend off weird ideas.
- 3.8.4 Theories do not act or perform anyhow in the history of science, but theories become selected by potential holders or dismissers¹⁷ according to the respective evidence (or the lack of it).

¹⁶ Saying that theories do not *actually* exist is of course just a special version of saying that propositions or meanings (or ideas) do not *actually* exist; this being a point of view which often led to Platonism. In this paper we will certainly not follow this lead.

¹⁷ Sorry, but sometimes (?) a little Germanism happens.

- 3.8.4.1 Theories as such do not act upon the actually existing world, i.e. theories as such do not influence, change or alter any actually existing entity or any of the interactions amongst these actually existing entities. Especially also a change of theories (i.e. rather a change of preferences by one or more scientists towards holding another theory instead of the one she or they did hold earlier) doesn't influence, change or alter any actually existing entity or any of the interactions amongst these actually existing entities.
- 3.8.4.2 Yet the *holding* of theories might perhaps *motivate* the respective holders to either act in a specific way or to perceive or observe things in a specific way and thereby that holding would perhaps somehow influence their so-called perceptions of the actually existing world. Holding a theory may motivate scientists even to do extreme things. But theories as such never do anything, never act upon anything, never interact with anything. This of course is a mere triviality but shifting the focus to that triviality might help against the tendency of anthropofying theories or else suddenly think of them as actually existing entities.
- 3.8.5 The actual subjective existence of the potential holders of a theory - including their motivations and convictions - has no relevance whatsoever for the truth and meaning of the propositions of the theory.

3.8.5.1 Any social or cultural context or any psychological or emotional disposition of the potential holders of theories doesn't affect the truth and meaning of the propositions of the theory in any possible way. Obviously such contexts or dispositions will affect the actual utterances of holders of theories in the same way as such contexts or dispositions affect the utterances of anyone who make any utterance. But the utterances of holders of theories are as such not the same as the propositions of a theory, not even the propositional content of such utterances is by itself necessarily equivalent to the propositions of a theory. To find out if there would be any sort of correspondence between these different kinds of propositions one at first would have to understand the theory and from that perspective judge the propositional content of the respective utterances. This of course is a mere triviality but shifting the focus ... (see above).

3.9 Now, what's really going on in that development of somethings (called 'theories') which allegedly do not actually exist but then somehow seem to have a history of their own?

3.9.1 For a first provisional answer the following must do:

3.9.1.1 It seems as if there would be a beauty contest going on for the relative splendor of being more right than the others at which the competing claims are supported (or not) by evidence (or the lack of it). As the jury in that contest act respective subgroups of (or entangled with) the scientific community having their

judgements more or less based on evidence. But even if this comes very close to what there is actually going on it only shows us half the picture.

3.10 There namely are rather two different struggles going on delicately interlocked.

3.10.1 The already mentioned contest is between the proponents of the theories and it is done by the mentioned betting and it is primarily about to be right, i.e. to get the higher score for example in right predictions or consistency.

3.10.2 The other struggle is much harder to understand. It is somehow in between the theories themselves and it is no more a contest at all and in particular it is no more for the relative splendor of being more right than others. Here instead everything is about the ultimate splendor of - oh yeah - truth.¹⁸

3.11 That later struggle will be the main topic of the last section of this paper where we will try our best to somewhat elucidate it. But by now the time has come to look for what we have achieved in this section in relation to our campaign against anti-realism.

3.11.1 And there we have to face a sobering result.

¹⁸ That will be the topic of this paper following sentence 5.6.

- 3.11.1.1 If theories do not interact with anything, i.e. do not influence, change or alter any actually existing entity and above all if theories do not even refer then realism(s) of all sorts they may be metaphysical, naive, scientific, internal, moderate, modest or any meaningful combination of these predicates has (have) to be refused.
- 3.11.1.2 Thus in our rigid campaign against anti-realism of all sorts we just have - it may be admitted - not even exactly by accident killed off realism of all sorts. A strategy which - at the first glimpse - would not appear to be the most target-seeking thinkable or to be overly inspired at all therefore calling it 'very unconventional' as we did at the beginning of that paper seems to be an euphemism as well as an understatement of sorts. So the only thing we can do in that unpleasant situation is to hope - for a second chance to come which then hopefully will show us a more pleasing picture.

4. THEORIES IN THEMSELVES: ONTOLOGICAL RELATIVITY

- 4.1 There is no ontology beyond the ontology/ies of (the) science(s)¹⁹.

¹⁹ Please note that the slash in 'ontology/ies' has not the same scope as the brackets in '(the) science(s)', therefore it follows that there are four different yet equally justified possible combinations signified.

- 4.1.1 An ontology is just an adjunct²⁰ to a theory.
- 4.1.1.1 An ontology just should be thought of as a (formally structured) set of all potentially comprehended and acknowledged objects stated by a respective (e.g. physical) theory plus all interaction structures presupposed or implied by the assumption of these objects (the explication of these interactions then being a part of the formal structure of the mentioned set).
- 4.1.1.2 An ontology - as just defined - therefore is inherently relative to the respective theory which implicates that ontology.
- 4.1.1.3 As an explication of that ontological relativity we describe it as the *inherent adjunctiveness of any ontology to a respective theory*.
- 4.2 Actual existence (including of course the actual existence of the actually existing world) is not an element of any ontology²¹, and that above all because it is not an object of any theory.

²⁰ By using the term 'adjunct' we try to emphasize on the one hand the (projective) generation of an ontology from the base of a respective theory (where the ontology then could be seen as something like an ontified dual of the theory) and on the other hand the prevalence of the theory with respect to its ontology.

²¹ The proposition that actual existence is not an element or part of *any* ontology relates also in particular to such chimeras as so-called 'fundamental' or 'existential' ontologies.

- 4.2.1 A theory cannot have any actually existing entity as a possible object of itself, because theories do not refer.
- 4.2.2 That actual existence is not an element of any ontology should already become obvious to anyone (somewhat informed) merely by the notion of ontology itself. Ontology means and equally meant to its first practitioners like Parmenides²² and Plato²³ a logos (i.e. a teaching or a doctrine) of the being.
- 4.2.2.1 But actual existence in distinctive difference to such a 'the being' is not a subject of any teaching or doctrines because it is not related to, not dependent on and not derivable from (any theses or axioms of) any teachings or any doctrines or any immature theories or science.
- 4.2.3 Therefore (*not* just as a gentle(?) reminder): Actual existence is an utmost radically pre-theoretical crude given the inner sense for which is ultimately and entirely founded in one's own certitude of being actually existent.

²² Please note: Parmenides of course incontestably not just intensely pursued ontological questions but even was the primary founder of that subject of ontology as such, *despite the fact* that he didn't use the *term* 'ontology' (which eventually had not been introduced before the early 17th century).

²³ Cf. the preceding footnote, exchange 'Plato' for 'Parmenides' and adapt accordingly (i.e. there is usually only one primary founder but possibly more than one primary scholar of a subject).

- 4.2.3.1 The preceding statements 4.2.2.1 and 4.2.3 (following the colon) claim an entirely different status than the similar sounding sentences 1.2.1 or 1.2.2 because these then had just been terminological preliminaries whereas 4.2.2.1 and 4.2.3 follow (ex negativo) from our foregoing arguments about the inherent adjunctiveness of ontologies to the respective theories.
- 4.3 A theory by no means ever can produce, create, designate, impart or bestow (the) actual existence for, of, to or on the potentially comprehended and acknowledged objects which that theory states to be its objects. In other words: *a theory doesn't ever yield actual existence*. From that follows
- 4.3.1 that the notion of 'ontological commitment' is - as the tacit proposition it was designated to be - completely meaningless because as it implies that one who holds a theory should feel (or be) committed also to hold the adjunctive ontology it proves to be nothing but a mere triviality. Anyone who seriously holds a theory cannot ever help also holding its adjunctive ontology. As a term then 'ontological commitment' turns out to be a sort of pleonasm;
- 4.3.2 that theories do not refer (on - what is often called - an 'outside world', i.e. on an extra-theoretical actually existing world). From that follows
- 4.3.2.1 again that (scientific) realism(s) of all sorts has(have) to be refused. From that usually is derived

4.3.2.2 a pile of ... - at least in so far as science is concerned - utterly unreasonable, unjustified and unwarranted - allegedly (implicitly) epistemologically founded - (mis)conceptions known as relativism, contextualism, deconstructivism et al. which all have in common that they are (at least implicitly) varieties of anti-realism.

4.4 Now again comes that nasty question up of what we have achieved in this section in our campaign against anti-realism.

4.4.1 And being deeply patient and humble²⁴ we remorsefully admit that even justified invectives (see 4.3.2.2) are not the best possible substitute for a striking argument. And we also have to admit that the picture we are now confronted with - if at all - changed for the worse since we looked at it the last time at the end of the previous section.

4.4.2 So we hear the triumphant joy of all these anti-realists and with our heart full of mercy we won't envy them their enjoyment - since we know the old wisdom: the end is - sort of - near.

4.4.3 To give - as it is good custom with such prophecies - a more exact date: the end is a little less remote than the length of the

²⁴ Or what's that synonym for artful?

next - which also happens to be the last - section of this paper.²⁵

5. INTERTHEORETICAL RELATIONS: ONTOLOGICAL ADJUSTMENT

- 5.1 But whatever could then be accomplished by theories, if theories do not refer?
- 5.2 To start answering with the very least: *theories implicate or postulate objects, i.e. theories essentially objectivate.*
- 5.2.1 Operating with theories then as a matter of course strictly necessitates operating with the objects of the respective theories. And exactly by doing so anyone who appropriately operates a theory inevitably performs a reasonable approach towards its implicated adjunctive ontology, i.e. its objects or objectivations.
- 5.2.1.1 Such a reasonable approach could - severely overdetermined - also be called 'ontological commitment' (but better shouldn't, see 4.3.1).

²⁵ If however it would be *exactly* as far remote as the length of the next section this indeed would not only be a very cheap prophecy but also a very devastating - at least for the prospect of our campaign. By the way that next section is unmannerly long.

5.2.1.2 But pretending that those objects of a theory would ever be in any sense related to or even be identical with actually existing entities²⁶ would be nothing else than ontological superstition.²⁷

²⁶ Thus here for the first time 'objects which are no entities' came across. They might be worth to retain.

²⁷ Unfortunately it was rather something of that sort what we just called 'ontological superstition' what Quine originally meant by 'ontological commitment'. Even though Quine would also have denied that theories possibly could ever refer (in a proper sense of that word), his respective denial was based on thoroughly different reasons above all on his concept of the underdetermination of the theory of nature (by so-called data). This famous concept despite being a philosophical icon revered by many could - perhaps a bit sketchy - be illustrated as pointing out some veil of fuzziness somehow wrapping up the so-called data in some opaqueness (which couldn't ever be completely overcome) and by that diffusing any definite relation from any particular theory to those 'data' thus effectively preventing the positive precision required for any (proper) reference. This then - so to speak - by 'retroaction' leads to the conclusion that potentially infinitely many theories - including mutually incommensurable ones - could be equally consistent with those data. The shortcut for this is called 'underdetermination of the theory of nature'. But there is more about underdetermination than just this 'linguistic' aspect. There is also an epistemological background of this concept from which it even originated. 'Underdetermination' as argued for by Quine in 'Word and Object' (cf. W.v.O.Quine, *Word and Object*, Cambridge (Mass.) 1960, 21ff, 26-35, 40-46, 78) is inseparably connected with a so-called stimulus meaning (cf. *ibid.* 31ff) which again is a home-bred concept of Quine based on a rather indefensible behaviorism. But all these obstacles and impediments to a relation of theories and 'data' do (at least for Quine) not preclude that relation as such. Quite on the contrary the concept of underdetermination itself strictly implies and requires such a - however diffused - relation somehow to exist. And it is exactly here where ontological commitment comes along as a call not to give up the loyalty to your theory just because of underdetermination.

In sharp contrast to such - except for (post)empiricism - baseless worries we would neither take any 'data' (in the mentioned sense) for granted (nor admit that such a concept has any significance) yet we would consequently deny that that claimed relation (as well as any reference of a theory to any actual existing entities, which of course are something distinctively different from 'data') exists at all.

- 5.3 Ceterum censeo: There is no ontology beyond the ontology/ies of science.
- 5.3.1 But the ontology/ies of science is/are not yet completely discovered nor is/are it/they neither comprehensively nor with exceeding depth understood, because for that being the case the ontology/ies of science would at first has/have to be founded in the ontology of the ultimate theory.
- 5.4 *An ultimate theory is anticipated and foreshadowed in the course of the history of science.*
- 5.5. *Such a kind of parousia of an ultimate theory anticipated in the course of the history of science comes to light by intertheoretical relations.*
- 5.5.1 The preceding statements 5.4 and 5.5 could easily be perceived as at best a rather fanciful version of pragmatism or worse than that as a severely chiliastic vision, but they are not meant to be either.
- 5.5.1.1 The second of these both dismal interpretations is not only the one which is the even more dismal but also the one which unfortunately will at this stage of our argumentation probably by many be seen as the more fitting as well. But soon it anyway will casually become obsolete.

- 5.5.1.2 There is much more about a certain seeming accordance with an imaginable somewhat teleological version of pragmatism.
- 5.5.1.3 What could - though in the end rather unjustifiably - be seen as the element of such a seeming accordance would simply be some partial similarity in the respective concepts of truth (which related to this paper still lurks behind the scene).²⁸
- 5.5.2 Such partial similarity in the respective concepts of truth would be based on only one partly common feature, namely the stand against representation theory of truth²⁹.
- 5.5.2.1 But as we later will see that stand against representation theory of truth comes in the case of pragmatism from entirely other

²⁸ But then also made a step forward lately.

²⁹ A representation theory of truth shall be defined in this paper as a theory of truth which states that a claim of truth (i.e. a claim of being true) of a theory or a claim of truth of a sentence (or a statement) of a theory is justified (or warranted or confirmed) if that theory (or respectively that sentence or that statement) corresponds to an extra-theoretical (or extra-linguistic) fact (of the so-called real world). The expression 'corresponds to' in the previous sentence means 'refers to in the way of an one-to-one mapping (or a bijective mapping or an isomorphism)'. Thus by substitution: a representation theory of truth states that a claim of truth of a theory (or a sentence etc.) is justified (or etc., see above) if that theory (or etc., see above) refers to an extra-theoretical (or extra-linguistic) fact (of the so-called real world) in the way of an one-to-one mapping (or etc., see above). A historical example of a representation theory of truth is the Thomistic adaequation theory of truth (*adaequatio intellectus et rei*). The 'correspondence theory of truth' of A. Tarski - which had been very unfortunately named this way - has been sometimes unjustifiably misinterpreted as a kind of representation theory of truth.

reasons³⁰ than in the case of *veracious objectivism*³¹ with *ontological adjustment* as we - admittedly a bit long-windedly - like to name our position. Obviously such difference in the respective reasons should not come as a surprise since pragmatism after all is a species of anti-realism which is something veracious objectivism with ontological adjustment of course shouldn't be.

5.5.3 Thus the distinctive difference between pragmatism and veracious objectivism with ontological adjustment now comes up exactly in respect to the same matter at which the seeming accordance of them both could have been found before, i.e. in respect to their concepts of truth. And this again should really

³⁰ And is as well conceived there under the premises of an entirely different conceptual scheme, namely a watered-down epistemological one.

³¹ I would have preferred to call that kind of 'objectivism' - which will be clearly presented in the following - 'veritative objectivism' but for not to overdo the introduction of neologisms I then decided to better drop that intention. Most important in the characteristic of the objectivism we will present is that it essentially has to do with truth, but that it is not at all in the common sense 'verificationist'. I.e. it is not about any justification or verification of sentences or the methodological reflection of how possibly to do so and it is also not about criteria, standards and measures relevant for such purposes. I.e. it is not about any potential *practice of verifying* but about something completely different and perhaps strange, namely about a certain self-contained process of the increase of truth. 'Verification' on the contrary suggests a *method or practice of gaining truth or making something true* and this is not implied in veracious objectivism.

Yet verificationism might be a effective if not the only way to accurately point out a reasonable notion of 'truth' for the ordinary language, but actually to do that would - in my view - be indeed a much harder task than for example just defeating anti-realism. One reason for the intricate difficulties of such a task would be the lack of the relatively invariant anchor of theories in ordinary language and the excess of arbitrary context-dependent belief systems instead.

not come as a surprise since - up from the beginning of this paper - we bluntly announced it as *anti-anti-realism with intuitionist negation*.³²

5.5.4 The concept of truth as proposed in veracious objectivism with ontological adjustment is - in sharp contrast to that of pragmatism - not at all dependent on any practice or utility and no pragmatic aspect of operating or propagating theories matters at all for the validity of truth as related to veracious objectivism with ontological adjustment.

5.5.5 Pragmatism of course is merely a special case of anti-realism in general. Therefore more generally speaking we say that the concept of truth as proposed in veracious objectivism with ontological adjustment is - in sharp contrast to that of anti-realism - not at all dependent on any extra-theoretical context be it pragmatic, social, cultural, psychological or epistemic in whatever disguise.

5.5.6 The concept of truth as proposed in veracious objectivism with ontological adjustment instead is found as well as founded in particular intertheoretical relations between certain successive theories.

³² For a more detailed explanation of what is meant by anti-anti-realism with intuitionist negation see the footnote of 5.16.

5.6 We will call that kind of intertheoretical relations the *intertheoretical truth-relation*.³³

5.6.1 In the following we will show that the intertheoretical truth-relation is designed as to be an application of the correspondence theory of truth which had been originally proposed by Alfred Tarski.³⁴

5.6.1.1 The 'correspondence theory of truth' had been sometimes misinterpreted by philosophers as a somehow formalized version of the Thomistic adequation theory of truth (*adaequatio intellectus et rei*), but it never was meant to be that, it never was that and it even never could have been that.³⁵

³³ For more details about the intertheoretical truth-relation cf. D.Kurth, *Der Weg der Wahrheit*, in: P.Eisenhardt, F.Linhard, K.Petanides (eds.), *Der Weg der Wahrheit*, Hildesheim 1999

³⁴ Cf. A.Tarski, *Der Wahrheitsbegriff in den formalisierten Sprachen*, *Studia Philosophica* 1, Leopoli 1935 (repr. in: *Alfred Tarski Collected Papers* vol. 2, Basel Boston Stuttgart 1986, pp 51-198). A further explanation of Tarski's concept of truth where he also deals with the philosophical interpretation of his theory can be found in: A.Tarski, *The Semantic Conception of Truth and the Foundations of Semantics*, *Philosophy and Phenomenological Research*, vol. 4, 1944 (repr. in: *Alfred Tarski Collected Papers* vol. 2, Basel Boston Stuttgart 1986, pp 661-699).

³⁵ Tarski's correspondence theory of truth is on no account about a correspondence between a sentence or proposition on the one hand and an (extra-linguistic) fact on the other. On the utmost contrary it states a correspondence between two sentences or propositions of which one is a sentence of a (formalized) object-language quoted in quotation-marks in Tarski's famous truth-matrix (see 5.6.1.3 of this paper) and the other is a respective version of that truth-matrix (or criterion of truth) itself which of course is a sentence of a respective (formalized) meta-language. Furthermore Tarski's correspondence theory of truth doesn't apply to ordinary languages anyway because an ordinary language is not a formalized *semantically closed* language; but - by the way - theories are.

5.6.1.2 The correspondence theory of truth was introduced by Tarski for purely (meta)mathematical reasons namely to explicate the *semantic* concept of truth³⁶ which is inherent in model theory of which Tarski was the primary founder.

5.6.1.3 The criterion of truth in Tarski's semantic theory of truth goes as follows

"p" is true iff p (1)

(1) simply says that a statement "p" of an object-language OL is true in a meta-language ML, in which also the predicate "true" is used, if and only if it is satisfiable in ML. Thus (1) first of all is a statement of ML. 'Satisfiable in ML' means that there must be a possible consistent and meaningful interpretation of "p" in ML. Such consistent and meaningful interpretations here are usually called 'models'. Then (1) actually says that "p" is true in ML if and only if there is a model p of "p" in ML. Which could also - a bit shorter - be expressed by (1*)

"p" is true in ML iff there is a model p of "p" in ML (1*)

and of course (1*) has to be a proper sentence of ML, therefore than the expressions 'in ML' and 'there is a model .. of "p" in

³⁶ In contrast to *syntactic* concepts of truth (as provability or derivability) which are characteristic for e.g. proof theory and most mathematical practice.

ML' turn out to be fully redundant and (1*) turns out to be a redundant version of (1).

5.7 Applying the semantic concept of truth in the field of intertheoretical relations for the purpose of establishing an intertheoretical truth-relation is definitely a bit more complicated as applying it in (meta)mathematical model theory.

5.7.1 The main objection against trying to do so would probably run under the title of incommensurability.

5.7.1.1 But that objection stands and falls with the (rather unreasonable) measure of commensurability it usually presupposes.

5.7.1.2 At least there are enough historical cases available which by a minute reconstruction could be shown to be proper examples for the applicability of that proposed intertheoretical truth-relation. Such amongst others are in particular the Newtonian revolution for which it can be shown that for Newton's theory of gravitation models - which indeed had to be slightly altered compared with the respective proper Newtonian models - could be constructed effectively matching Galilei's theory of gravity, Kepler's theory of planetary motion and Huygens' theory of the motion of the pendulum. And the same applies to Einstein's

theory of general relativity with respect to Newtonian gravitation, Einstein's own special relativity and by that of course also Maxwell's electrodynamics.³⁷

5.7.2 Of course the crux of that matter has to do with the mentioned 'slight alteration'. But then this is altogether a technical question concerning actual reconstructions of such stages of scientific progress, and there are no a priori arguments against

³⁷ But then immediately a note of caution must be made. There are of course also - more or less - directly succeeding theories to which such an intertheoretical truth-relation is not or only in a drastically altered way applicable. The later are for examples cases in which the succeeding theory would not be inherently improved, i.e. for example a case where there would be no amplification of the original scope (or extension of the preceding theory) be found in the succeeding, i.e. relatively new theory.

A good example for that is the intertheoretical relation of the Ptolemaic and the Copernican system despite the fact that this so-called revolution is usually rated as one of the outstanding popular examples of scientific progress. Yet in fact it was mainly a transformation of coordinates. Both theories are purely phoronomic theories, i.e. they contain and imply no relation whatsoever to any dynamical concept or aspect. By calling these theories 'phoronomic' it is also meant that they are not even just kinematic theories, since being a kinematic theory implies by the historical introduction of kinematics well enough a relation to dynamics, namely a relation of methodically skipping the nevertheless strictly presupposed and recognized dynamical causes of the considered motion. But such causes haven't been at all considered in either the Ptolemaic or the Copernican theory.

And as just a phoronomic theory the Ptolemaic was the better one, i.e. it significantly better matched the observations. The main reason for that has to do with a technical aspect, namely the punctum aequans which comes surprisingly near to the empty focus of Kepler's ellipses. Therefore the planetary motion if represented as seen from that punctum aequans as well would surprisingly resemble that which is known from Kepler's theory. And - by the way - the Ptolemaic theory could do with fewer epicycles than the Copernican.

The true revolution initiated by the Copernican theory was of course in regard of its consequences for respective doctrines of the church and by that for the entire weltbild of that time in history.

the possibility of an appropriate minute reconstruction of respective cases. i.e. reconstruction as such by no means implies incommensurability.

5.7.2.1 And for now that must do as a preparation for introducing the intertheoretical truth-relation.

5.8 As an application of the semantic concept of truth the intertheoretical truth-relation goes as follows

T_2 : " p_{T_1} " is true iff $M^* p_{T_1}$ (2)

(2) says that a statement " p_{T_1} " of a preceding theory T_1 is true in a succeeding theory T_2 if and only if there is a *peculiar* model $M^* p_{T_1}$ of " p_{T_1} " in T_2 .

5.8.1 What we have done here obviously is to take a succeeding theory T_2 as a kind of meta-language related to a preceding theory T_1 as the respective object-language.

5.8.2 The *peculiarity* of $M^* p_{T_1}$ (expressed by the asterisk) is altogether due to the crux concerning the mentioned 'slight alteration'. Obviously in many cases in which the intertheoretical truth-relation might be applicable and then especially in the more interesting ones there will be no proper model of a statement of a preceding theory T_1 found as well to be a proper model of a respectively succeeding theory T_2 . Instead in T_2 there must at first be a new model constructed

only for the purpose to satisfy for " p_{T1} ". Such a new model then would probably differ significantly from the proper models of T_2 . It would probably be characterized by restrictions compared with the respective proper models of T_2 , i.e. important features of T_2 would become meaningless in the particular context of that peculiar model M^*p_{T1} and - somehow as a 'substitute' - different theoretical terms would probably ad hoc be introduced which would be seen as meaningless in T_2 . Altogether M^*p_{T1} of course would be quite transmogrified compared with the proper models of T_2 , i.e. it would only be a very partial model of T_2 and even as such it would look rather bizarre.

- 5.8.3 But such features or theoretical terms becoming or being *meaningless* would as long be of no relevance for a possible reconstruction of " p_{T1} " under the auspices of T_2 as long as such a reconstructed model M^*p_{T1} would not be *inconsistent* with T_2 .
³⁸ And in the eyes of some looking bizarre might even be fashionable.

- 5.8.4 Now we hope to somewhat have elucidated the rôle that uncommon 'veracious' has been designated for to play in veracious objectivism with ontological adjustment, but what's about the other elements of that long-winded expression?

³⁸ Could it possibly be the case that some anti-realists should get a creeping feeling as if some of the stuff they usually like to throw at others comes flying back?

5.9 *Objectivism and ontological adjustment will eventually go together.*

5.9.1 Objectivism could easily be explained as a position standing for the argument that there are possible statements or sentences the asserted truth of which is valid utterly independent on any direct or indirect subjective motives, contexts or pre-understandings. The subjectivity in question must not be confined to an individual but could also be incarnated in social or cultural contexts, influences or traditions. But there is essentially more about objectivism than such an ordinary definition could bring out.

5.9.1.1 Objectivity as pointed out in 5.9.1 could obviously be only found in theories. And that is so not primarily for the incorruptibility by which theories come to their judgements since theories do not come to any judgements anyway.³⁹

5.9.2 But it is so for the fact that *theories objectivate*.

5.9.2 1 Now, 'objectivation' is admittedly a neologism but then it is also nothing really new, at least not in this paper. 'Objectivation' is just the term we use to describe the fact that a theory implicates the totality of its objects (including all

³⁹ This was a bit unfair, but actually theories also do not come to *conclusions*, but only scientist do so by using theories. Theories *as such* contain no conclusions but - at best - just implications. This - by the way - marks an important difference of the works of scientists and detectives.

relations between them)⁴⁰, i.e. its ontology (cf. 5.2.1), which again is the ontology of the stated facts of the theory.

5.9.3 So we should better say: that *theories objectivate factually*. Factuality now is - so to speak - the meta-ontological counterpart of actuality, namely the way the *intelligible objects* of theories *intelligibly meta-exist*.⁴¹

5.9.3.1 And to say that a theory implicates the ontology of its stated facts is again rather a further explanation of the statement that any theory has its ontology just as an adjunct (cf. 4.1.1.3 and 4.3.1). But when we dwelled the question of an ontology merely being adjunctive to a respective theory then these ontologies had been quite relative. And that was a bit 'bad'.⁴²

⁴⁰ Of course this includes as well all relations of higher order like functions, functionals etc. and by that in the end the network of the entire formal structure of which the primitive objects merely mark some crossings of the ties.

⁴¹ For pointing out the distinctive difference of the status of theoretical objects on the one hand and actual existing entities on the other we have to use some telling predicates. But by using 'intelligible' in contrast to 'actual' (see also 3.8.3 of this paper) or 'meta-exist' in contrast to 'exist' we do not want to imply, indicate, insinuate in any way that we tend to a dualist or Platonist position either in 'ontology' (as it is traditionally understood) or in the theory of universals. On the contrary: we oppose dualism and Platonism vigorously in any of its appearances. But all these subjects are not the topic of that paper so we only can assure you if there would be more time we could bring forward the required arguments to show why we do so justifiably. Just to give a hint: such arguments would probably have to do with an *appropriate* kind of neutral monism and - by the way - with the fact that 'meta-existence' obviously does *not* imply 'pre-existence'.

⁴² I.e. it is 'bad' in our view, not only because it is so fine in the anti-realists view but also for that reason.

Therefore time has come to put that overdone relativity of the ontologies in order, i.e. *to adjust the ontologies*.

5.10 *Ontological adjustment means that the ontologies of respectively appropriate theories become adjusted in the course of the history of science by means of the intertheoretical truth-relation.*

5.10.1 Truth as increasingly revealed or discovered by subsequently succeeding theories is then an *entailment* of these theories which are linked by the intertheoretical truth-relation in the history of science.

5.10.1.1 Already the truth of the first theory - which satisfies the required standard of formalization, namely the 'theory of planetary motion'⁴³ by Hipparchos of Nicaea⁴⁴ - as *revealed or*

⁴³ To be a bit stubborn: 'Theory of planetary motion' is of course just a name because there is no, there never was and there never will be a theory of planetary motion, if one understands by 'planetary motion' an actual happening going on in the actual existing world. This of course doesn't relate specifically to a theory of planetary motion but equally to all theories. Yet it might become more evident in a case like Hipparchos' theory since today hardly anyone anymore would believe that planets run on epicycles which themselves run on a deferent.

⁴⁴ We don't say or want to imply that Hipparchos' theory was actually the first theory in the history of mankind's endeavours of theorizing, but it is - to our knowledge - the first one of which we have enough hard information for the purpose of reconstructibility and a respective degree of formalization on the one hand and for which a clear link to succeeding theories can be shown on the other. Yet any other possibly more ancient theory be it of Babylonian, Egyptian, Indian, Greek or whatever origin which would meet a comparable standard could of course turn out to be the 'true' first theory. The link to succeeding theories wouldn't even have to be to the same type of theories, namely an astronomical or phronomic one, as it is the case for Hipparchos' theory.

*brought into appearance or discovered*⁴⁵ by its actual successor theory (which could in fact be as far remote as the theory of Tycho Brahe⁴⁶) is an *entailment* of all succeeding theories eventually up to the ultimate theory.

5.10.2 But it is of course not the *proper ontology* of the theory of Hipparchos or the quite equivalent one of the Ptolemaic system which will eventually become a proper part of the proper ontology of the ultimate theory. It didn't even become a proper part of the proper (and of course mutually distinct) ontologies of Tycho Brahe's, Kepler's or Newton's respective theories.

5.10.2.1 The proper ontologies of the different theories in the history of science still remain to be relative.⁴⁷ But they are linked by the reconstructed, i.e. 'slightly altered' models⁴⁸ as outlined related to the intertheoretical truth-relation.

⁴⁵ I am not at all interested in the meaningless discussion if theories 'discover' or 'invent' their assertions. Such a discussion would only make any sense at all under the assumption that a representation theory of truth applies. But there is a meaningful interpretation of 'discovery' which doesn't imply such epistemologically contaminated connotations. It goes in the direction of the meanings of for example 'making something apparent', 'bringing something into appearance' or 'reveal something'.

⁴⁶ Since the Ptolemaic system was merely a strictly conservative extended application of Hipparchos' theory and the Copernican system was mainly a transformation of the coordinates of the Ptolemaic system But there are also arguments for the usually hold opinion that the Copernican theory would be an appropriate candidate.

⁴⁷ But from now on that relativity shouldn't be anymore so much overstated as it has been frequently done.

⁴⁸ Yet sometimes a rather *hefty slightness* (sorry) might have to be applied.

5.10.2.2 And it is by the chain of subsequent intertheoretical truth-relations how the true substance⁴⁹ of these relative adjunctive ontologies becomes refined. Refinement then means that only these elements, parts or aspects of the adjunctive ontologies of preceding theories maintain significance (i.e. are regarded as being true in the context of an appropriate reconstruction) in the course of the history of science which can be linked by the intertheoretical truth-relation with appropriately altered models of a succeeding theory (at which these models could also be accounted for as potentially meaningful).

5.11 Thus ontological adjustment is exactly this process of refinement, i.e. the subsequent pointing out of appropriately altered models of theories in subsequent applications of the intertheoretical truth-relation.

5.11.1 Since the adjunctive ontology of a theory is nothing but the entirety of the models of that theory we are entitled to speak of ontological adjustment despite the fact that the proper ontologies of the original theories still remain relative.⁵⁰

5.11.2 Now, what's still left to do? Oh yeah, there was that 'severely chiliastic vision'. Now, I suppose that no one at least a bit

⁴⁹ Which stands for a dynamically increasing core or generative invariant of reconstructible claims of truth in the history of theories.

⁵⁰ It sometimes helps to think about intuitionist logic, i.e. intuitionist negation in particular.

reasonable could mistake veracious objectivism with ontological adjustment or that process of refinement of the ontological substance (sometimes simply called: truth) by the means of iterated applications of the intertheoretical truth-relation for a severely chiliastic vision.

5.11.2.1 But then there was also that reference to an ultimate theory, supposed to be anticipated and foreshadowed in the course of the history of science.

5.12 That science has an inherent tendency towards unification and thereby an increase of the internal complexity of the succeeding rather more unified theories compared with their respective less unified predecessors should be evident to anyone who ever looked a bit deeper at the history of science, not at least at the rather later stages of it.

5.12.1 Therefore the presumption of an ultimate theory to come is nothing more than a simple extrapolation of that inherent tendency severely enforced by the implications of veracious objectivism with ontological adjustment, in particular of course by the intertheoretical truth-relation.

5.12.2 An ultimate theory should not be thought of as being something mysterious. An ultimate theory will not refer more to the extra-theoretical actually existing world than any other theory ever did, i.e. it will not refer to that at all. And by that

an ultimate theory consequently has ever to be regarded to be just a provisional ultimate theory.

5.12.2.1 No actual theory ever could be rated as the ultimate theory beyond any possible doubt, i.e. any apparently ultimate theory could turn out only to be - so to speak a little bit seemingly paradoxical - a provisional ultimate theory. But this of course would not devaluate the significance of the concept of an ultimate theory since that turn from the status of an ultimate theory actually recognized as such to a status of a merely former ultimate theory could only take place by the actual establishment of a then newly accepted ultimate theory thoroughly encompassing its predecessor (as always in the history of science).

5.12.3 Therefore it must be said, that the concept of an ultimate theory is sort of a very modest one. I.e. it only implies that the ontology of the ultimate theory provides the utmost true factual objectivation corroborated by a maximum of evidence and validated by the greatest possible coherence, i.e. the maximally attainable truth. But that's already the main point of it.⁵¹

5.13 And now the time eventually has come to make good for our prophecy in 4.4.3, since that last section of that paper meanwhile became a bit lengthy.

⁵¹ Fortunately there can be found various other types of modesty too.

- 5.13.1 In the beginning of this paper we proposed that realism and anti-realism would show some equivalence under a certain aspect and that anti-anti-realism with intuitionist negation would not do so. And we were hopeful that in the course of the paper that aspect would come to light. And so it did.
- 5.14 That certain aspect is the underlying theory or standard of truth, namely a common fixation of anti-realism as well as realism to a representation theory of truth.⁵²
- 5.14.1 Thus that's the gist of the matter both realists as well as anti-realists deeply believe in the representation theory of truth as the natural and only possible standard of truth. One difference however lies in the fact that poor realists honestly believe in that bogus, but some tricky anti-realists don't even believe in their beliefs.⁵³⁵⁴ Various realists believe in representation

⁵² More than 10 years ago Peter Eisenhardt several times energetically used to stress that theories would not be something like window glasses or spectacles. At that time I wondered what he wanted to say in particular because I knew that he was not in favour of externalism (in the philosophy of science) or instrumentalism. Now I tend to think that it then was his way to show his reservation relating to a representation theory of meaning (with respect of theories).

⁵³ Yet in the case of some anti-realists not to believe in their own beliefs then could be rated as a first indication of becoming reasonable, so maybe they believe in their beliefs indeed.

⁵⁴ Just another try to bring the message out: most realists view theories as if they would be something like (slightly abstracted and remarkably clear-sighted) persons, some anti-realists (for example radical constructivists) tend to view persons as if they would be something like (slightly animated and severely handicapped) theories; both views are mistaken.

theory of truth in the sense that they in different degrees of intensity believe that its promises are more or less redeemable. Various antirealists instead believe⁵⁵ in representation theory of truth in the sense that they in different degrees of intensity do *not* believe that its promises are redeemable. And based on this then they say that *for that reason* there would be no relevant notion of truth in science (or at least that in principal truth would not be attainable in science).

5.15 All the trick of that argument is concealed in that '*for that reason*'. That's the place where they hide the tell tale trace which leads to the evidence that they inconsistently adhere to the representation theory of truth and refuse it *at once*.

5.16 Anti-anti-realists with intuitionist negation⁵⁶ instead hold that the representation theory of truth is at best an obstinate illusion

⁵⁵ I.e. accept it as a relevant measure which can be matched or not be matched or - in an extreme version - even never actually be matched, but even for that extreme version then still serve as the tacit measure.

⁵⁶ OK, now then the definition: anti-anti-realism with intuitionist negation states *similar* to anti-realism that the common prevailing standard of truth as set by realism is unwarranted. Yet anti-anti-realism says so for an entirely different reason than anti-realism. Anti-anti-realism holds that standard as being *meaningless*, anti-realism holds that standard as being irredeemable. Then anti-anti-realism with intuitionist negation as presented in this paper provides an alternative standard of truth whereas anti-realism laments or rejoices at the seeming fact that there would no (claim of) truth be redeemable in scientific theories. I.e. anti-anti-realism with intuitionist negation negates anti-realism obviously without becoming realism again. This also will provide us the means to then finally dismiss any of such expectable arguments claiming that veracious objectivism with ontological adjustment enforced by the intertheoretical truth-relation would in the end just be a special sort of anti-realism.

or worse an utterly meaningless and severely misleading fixed idea.

- 5.17. Truth instead emerges together with the emergence of proper scientific theories and increases in the course of the history of science.

ADDENDUM:

Now the end of this paper comes really somewhat nearer and therefore the day of judgement not just for the sceptics but even for all the remaining anti-realists has come.⁵⁷ That might turn out to be a bit boring or redundant since all the basic arguments have been already presented but as a matter of fact we planned our campaign methodically and we will also bring it to an end this way.⁵⁸

⁵⁷ The end announced in 4.4.3 already came in 5.15.

⁵⁸ And to be honest now *we* want to have some enjoyment to *our* taste. Our very unconventional strategy - announced in the beginning of this paper - of course was to at first build up the most conclusive and - as in particular the many readers which are partial to realism will agree - even quite radical anti-realist position. In the course of that build-up we then sorted out the not so conclusive varieties and after having admitted the genuine conclusiveness we showed that it eventually cannot stand firm against the exposure of that not so little (and even not so secret) dirty secret of anti-realism namely sharing the same attitude towards truth with realism. This secret being nothing than the enshrined idol of epistemology.

But let's proceed step by step and start with the steadfast sceptics. For the sceptics namely the day of judgement is rather - literally - the moment of truth.

Let's at first recapitulate the sceptics' argument or rather his two arguments linked by a peculiar and unwarranted implication. The sceptics (in various versions and with various qualifications) essentially say

(1) that there is no reliable⁵⁹ objective knowledge of the outside world⁶⁰ attainable and

(!) *for that reason*

(2) that there is no 'truth' ascribable to theories.⁶¹

Now, we are *not* in any discussion of (1) since we hold (1) for being a meaningless play of words⁶², and - what's most important - we, i.e. the

⁵⁹ The difference between the various kinds of sceptics reaching from radical to moderate ones is mainly about the degree of reliability.

⁶⁰ I.e. of course the world outside of the consciousness of a respective subject.

⁶¹ That ascribability might be qualified as 'legitimately', 'justifiably' etc., but that makes no difference.

⁶² And we did thoroughly justify that standpoint by the argumentation in that paper concerning the misconception of possibly having objective, i.e. theory-based knowledge of the actually existing world. The real problem is of course with the notion of 'knowledge'. Realists as well as anti-realists use this term as if it could be taken as an unspecified comprehension of practical, so-called empirical and theoretical knowledge. But practical skill - even very generalized and methodically organized versions of this - belonging to the realm of actual existence on the one hand and theoretical knowledge on the other are entirely different things whereas so-called *empirical* knowledge is a

proponents of veracious objectivism with ontological adjustment enforced by the intertheoretical truth-relation⁶³ are *in no way obliged* to be in a discussion of (1) to defeat the claims of the sceptics as stated in (2). The reason for this of course is that we explicitly presented a concept of truth that in no way relies on epistemological presuppositions as stated in (1) and which will be valid independently of the fact which of the following cases applies to the assertion (1) of the sceptics namely if it would turn out either to be justified or to be unjustified or - what it is in fact - to be utterly meaningless.

But now let's change sides and have a look how the sceptics or any anti-realist might try to defend their conviction.

How then could a sceptic or any anti-realist try to defy veracious objectivism as outlined before in that paper? In the first instance such defiance doesn't seem to be a task too hard. The sceptic simply could assert that veracious objectivism as outlined in that paper is unwarranted, i.e. false. Which would be the same as saying that veracious objectivism doesn't give the right picture of the history of science, in particular that the proposal of an intertheoretical truth (or correspondence) relation is unwarranted. But as being a proper sceptic a sceptic is not entitled to do

misconceived mongrel brought up by erroneous epistemologies. (Don't worry about that 'realm' we still maintain our rigorous anti-Platonist stance.)

⁶³ From now on we refer to 'veracious objectivism with ontological adjustment enforced by the intertheoretical truth-relation' a bit shorter as just 'veracious objectivism'.

so, because scepticism is an essentially epistemological position defined by - rather ridiculous yet nevertheless purely - epistemological convictions.⁶⁴ Therefore by raising such objections (as mentioned before) against veracious objectivism the sceptic already has ceased to be a sceptic. Because even if he would be right, such objections would be no epistemological objections at all but purely factual objections decided upon by arguments concerning the philosophy and history of science. The sceptic anyway would then have transformed into a sort of relativist or contextualist or social constructivist, and would as such also be obliged to bring some respectively relevant arguments forward.

A sceptic of course could be more intelligent than doing so (especially considering the appalling consequences). He could either say he wouldn't care at all about veracious objectivism or that even if veracious objectivism would provide an appropriate picture of the history of science (with some inherent function of progress) he still would not care because an appropriate picture of the history of science by no means would yield or guarantee an appropriate picture of the real world. Especially that later argument seems to make a hit. But then it also indicates a fatal inconsistency (which applies as well to the simple denial to care at all about veracious objectivism) in the sceptics seeming argument.

⁶⁴ But note: that sword doesn't cut at all at both sides. We, i.e. the veracious objectivists (as alluded to in this paper), didn't ever use any epistemological arguments. Just to the contrary veracious objectivism implies that epistemological arguments are of no avail whatsoever concerning the question how the scope of scientific theories in the course of the history of science widens or how the set of true propositions (or models) of the theories increases in the course of the history of science.



By denying veracious objectivism any relevance for the question concerning the true picture of the real world the sceptic sets a *standard* for what such a picture would have to be. And it is no wonder that the standard he must set is simply the standard of realism.⁶⁵ To defend that standard of truth he then inevitably would have to recur to a sort of representation theory of truth like for example the Thomistic adequation theory of truth (*adaequatio intellectus et rei*) and that of course is what he cannot do as a sceptic. The only thing what is left to the sceptic then is to say that a representation theory of truth is utterly irredeemable (by his defining presupposition for being a sceptic) on the one hand but that it is also his strictly presupposed standard of truth on the other. *And thereby the inherent inconsistency which is as well the principal trick of scepticism became apparent.*⁶⁶

Thus *nothing* helps him out against veracious objectivism because this position is in no way whatsoever related to a representation theory of truth, and so we are not obliged either to join his lamentations or - as realists would be - to try to convince him of the opposite concerning his view of the redeemability of the representation theory of truth. Yet the sceptic would still be obliged to argue against the assertions of veracious objectivism in case he would intend to stay in the discussion at all. And by doing so he would cease to be a sceptic and this time even finally. By refusing to do so he would be out of the discussion exclusively by his own fault.

⁶⁵ This might seduce us to the innuendo that a sceptic - or for that any anti-realist - is in fact just an offended realist.

⁶⁶ Cf. sentence 5.15 of that paper.

But what's about the other remaining anti-realists - the relativists, contextualists and social constructivists - for they at least seem not to argue based as exclusively and specifically as sceptics must do on epistemological convictions. I.e. they seem to skip the argument (1) of the sceptic and just to hold on to the second argument (2). This is also the position the sceptic's one would have turned to by him seriously trying to stay in the discussion with veracious objectivism after having been defeated, i.e. proven to be inconsistent relating to his first argument (1).

But one has to note that meanwhile something important has changed concerning the possible effectiveness of the usual tactics of such remaining anti-realists. The exit to the usual escape route of these relativists, contextualists and social constructivists et al. has been finally locked up. I.e. if challenged on the field of the history or philosophy of science most of them sooner or later often try to retreat to a rather unspecified scepticism, which at least is a revelation of the fact that that actually is their tacit presupposition providing the base of their argument. Yet this escape route now is no more available for them. Therefore it all boils down to an argument about the proper history and philosophy of science.⁶⁷ There are of course no a priori arguments concerning that matter. But there is the challenge of an internalist reconstructional ansatz based on the intertheoretical truth relation (or an implicated entailment theory of scientific truth) to the externalist (mis)conception of the history of scientific theories as the narrations of its various (social, cultural, biographic etc.) contexts.

⁶⁷ And this evidently holds as well for the cases in which the respective anti-realists are *not* (explicitly or tacitly) affiliated to a proper epistemological position.

Then there is a comparably sober kind of anti-realism left namely instrumentalism which wouldn't deny that there is truth gainable by theories and that this truth could even increase in the history of science. But instrumentalism would put a certain reservation forward relating to a presumed distinction between different asserted qualifications and consequently varieties of truth itself. This asserted difference would be seen by instrumentalists as being between the attainable truth provided by the fitness or capability of steadily improved theories on the one hand and the unattainable ideal of an authentic truth thought of as representing the entire real facts. And already claiming such a distinction between those two kinds of truth is just the same as claiming that a representation theory of truth could be justified and valid. But we have tried to show for the philosophy and history of science that such validity or even any possible applicability of a representation theory of truth with respect to either theories as such or the history of science should better be precluded. There is no meaningful difference justifiably conceivable between a maximal and a maximal attainable truth, and asserting such a difference reveals again just a fatal inclination to the representation theory of truth and by that the inherent inconsistency of anti-realism becomes apparent once more.

SUBJECTIVE “I” REQUIRES EXTENSION OF INFORMATION PARADIGM

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ABSTRACT

Ken Wilber's theory of holons clearly describes why subjective and objective realities are distinct. Traditional information theory exclusively deals with objective reality while missing or ignoring subjective reality altogether. Yet, both subjective and objective existences exhibit informational characteristics. This paper will enumerate these two kinds of informational properties and distinguish how they both must coexist.

This understanding is based on modern research relating information theory and quantum gravity. Current public understanding and mindset regarding the nature of information theory is not keeping pace with this highly technical field. The new unified quantum gravity theories are implicitly linked with thermodynamics and information theory. These theories imply that information and energy have a duality relationship

resulting in paradoxical understanding just as earlier in this century particle-wave duality was seen as paradoxical. For example, a black hole's event horizon entropy measure is really an information metric more than an energy metric, since a quantum "bit" thrown into a black hole actually increases surface area by a minimum amount [1]. Bits are not purely mathematical anymore, but also not purely energy/matter either.

This duality leads to the possibility, as proposed by others [2], that information is more fundamental than energy. This approach says a lot about the nature of the information-energy duality, especially the interdependence of these two distinct properties. If information is truly more primitive than energy or matter, then it must also naturally be more fundamental than time and space. Informational like structures supporting quantum gravity theories must predate energy/matter and space/time encodings, yet impact physical reality.

This non-local and atemporal information understanding and thought process is the key to comprehending informational properties for subjective realities. This informational infrastructure must not only be the basis for all of physical nature (including quantum mechanics) but also the basis of all "hard problems" of consciousness. The modern information-energy duality will be explored in relationship to the subjective-objective nature of consciousness and information theory. Understanding and accepting this duality is the key to comprehending that paradoxical nature of consciousness and presumed mind/matter interaction.

1 MODERN INFORMATION THEORY

Information theory has been changing dramatically over the last decade. The traditional information theory from 50 years ago was primarily focused on communication theory. This focus leads to an emphasis on communications energy, especially related to signal to noise ratios. Many scientists and layman therefore mistakenly believe information is synonymous with energy. Modern quantum gravity research [3] and its relationship to thermodynamics has uncovered a slightly different view of information and its measure as “bits”.

The primary difference between communication theory and modern information theory is the primary unit of information the “bit” must be comprehended in physics as well as mathematics. This should be no surprise since the mathematics of entropy and information theory always used the same formulas.

A bit has meaning even in quantum mechanics and can be represented as either spin up or spin down. This encoding of a bit must be consistent with the physics of quantum gravity and thermodynamics, even though it does not represent a true energy encoding. Any quantum encoding of a bit has been shown to increase the size of a black hole (by Planck’s area), when that bit is thrown into a black hole [4]. In fact, a black hole can actually be thought of as a bit bucket or bit blender since its bit related surface area is its entropy measure.

What this all means is a bit represents an equivalent energy but requires a separate information accounting ledger since encoding of bits using

quantum states are separate from energy balance sheets. These quantum states can affect energy but are not energy, nor are even limited by the normal energy constraints of space and time. In fact, because of these properties, quantum states can be thought of as “subjective” since there are not directly measurable unless they interact with other quantum states to form objectively measurable energy patterns. Of course, these states are statistically repeatable.

Information theory applied to purely energy systems therefore represent traditional objective information metrics as found in communications theory. Systems such as quantum mechanics that represent pre-energy encoding of bits (such as quantum states) require another model of information theory. This alternative “subjective” paradigm for information bits is not restricted by normal spacetime or normal objective energy metrics and can be viewed from a more purely mathematical view.

2 SUBJECTIVE INFORMATION THEORY

The term “subjective” was chosen for this discussion to build on the holon model promoted by meta-theorist Ken Wilber. This model suggests that everything can be viewed from four perspectives organized as a two by two grid of four quadrants as seen in figure 1 below. The two rows are labeled individual-collective and the two columns are subjective-objective.

Subjective Individual I	Objective Individual It
We Subjective Collective	It Objective Collective

Figure 1. Holon Quadrants

Wilber discussed in his book “A Brief History of Everything” [5] how traditional information theory can be mapped onto the objective or external view of the world. He says traditional objective bits do not deal effectively with subjective states such as emotions or values. Scientists that take a reductionist view of internal states produce a category error that incorrectly collapses the four quadrants onto only two. This is an error since Wilber’s holon model deals with both quantum states as well as consciousness experiences.

This paper adopted his model and terminology since internal or subjective states (such as within a black hole or human consciousness) can **not** be directly probed to discover its contents. This strongly suggests that the information paradigm for inaccessible subjective (or internal) states may be distinct from objective energy dominated information models. Of course, this does not mean these states cannot be studied.

This non-energy information model is also the pre-time and pre-space representation for information. Both quantum mechanics and consciousness have produced examples of non-local and atemporal effects [6]. Yet both have information like properties and laws.

Physical laws are really consistency relationships that must be maintained instantly without actually using energy transfer. Conservation of energy is such a consistency law. Conservation of quantum states is also a non-energy consistency relationship. Even human behavior can be viewed as consistency with prior learned behaviors. Modern physics laws are heavily dominated by consistency relationships rather than conservation laws.

Consistency relationships are in reality an information term whereas conservation is a term biased towards an energy perspective. This is particularly true for the quantum EPR experiment where describing it from an energy perspective makes it completely paradoxical because of the atemporal and non-local consistency properties being maintained.

This energy versus information paradox is very similar to the well known particle-wave duality (and paradox) from the beginning of the century. This paradox was resolved by realizing that both perspectives are present all the time. What question a scientist asks determines the kind of response one receives.

Likewise, the information and energy paradox is also always present due to internal non-energy quantum states and external energy states. As in EPR, these quantum states can intermingle with other states and then later produce energy effects that are separated in both space and time. This

paradox maps identically to the holon model where subjective information states are non-energy (or non-time or non-space) constraints whereas objective states are identical to the traditional objectively visible communications model.

This line of reasoning is naturally related to human consciousness because internal non-energy, information-like, states of quantum mechanics have been proven to impact the energy results of the external physical world, just as what must be going on to support nonenergy based consciousness mechanism. In fact internal information-like consistency is just another physical law in addition to normal physical energy conservation.

This is particularly interesting to the Tucson conference in the face of quantum models of consciousness proposed by others. Subjective information theory must cooperate with energy models, such as quantum gravity, but information in general can have non-energy encoding. Most likely this encoding takes on the form of higher dimensional topological structure as proposed by modern quantum gravity theories [7].

This “subjective” information model suggests highly intermingled internal states that can not be easily observed from an external view. In fact, these internal states are not localized in space nor time like traditional energy based objective databases. In addition, full access to internal (or quantum) states has been proven impossible.

In an effort to duplicate these nonlocal effects, many scientists have proposed holographic memory to mimic this style of information organization [8]. Unfortunately, this solution only mimics the spatial part

of the solution and not the atemporal properties. Conversely, quantum computation [9] obtains access to the quantum time attributes leading to the new complexity class of quantum polynomial time solutions to exponential problems using quantum computers. This is so significant that quantum computers can do something that conventional computers are not capable of, that a large amount of research has spawned in this area, including the idea of biological based quantum computing to explain consciousness [10].

This section concludes by restating that subjective information theory is distinct from traditional objective information theory because internal state is maintained using a non-energy encoding. Subjective states are inaccessible to objective information systems because a “bit” is encoded as a non-local and atemporal constraint, similar to qubit in quantum mechanics. This non-energy memory/communication mechanism can not be simulated using energy systems and has no parallel outside a real, high dimensional, topological fabric supporting the presumed quantum gravity based universe.

3 SUBJECTIVE INFORMATION DOMAIN PROPERTIES

The previous section outlines why the information properties pertaining to subjective information states (and consciousness) are different than energy dominated information models. This was built on Ken Wilber’s holon theory that clearly defines why subjective and objective views of reality are distinct. His personal experience with expanded states of awareness is folded into his model.

Several consciousness related puzzles are now more understandable as a result of this subjective information domain orientation.

- A. Subjective states and quantum states appear to share many similar information properties. Quantum gravity theories must include information theory as well as thermodynamics. Why not have such universal mechanisms also include non-local properties exhibited by humans.
- B. All quantum gravity theories have concluded that spacetime is ultimately discrete at the size of Planck's length. This shows that quanta, bits and consistency rules dominate all of physics.
- C. Subjective states are not directly accessible by energy measurement systems, which is consistent with both holon and quantum theories. Until his death early this year, Willis Harmon [11] lectured on this theme stating the importance of cataloguing subjective states requires an expansion of scientific method to include statistical methods of inquiry, versus the denial of the validity of non-physical internal (or subjective) states.
- D. Consciousness research teams should ultimately include technical people on the teams along side the biologists, neurologists, doctors and psychologists. Likewise quantum gravity theories that excluded consciousness will most likely be incomplete.
- E. If human consciousness and information mechanisms rely on quantum-like states, then it is no wonder that nobody has ever

“measured” consciousness. Likewise, chi is known to be generated by conscious intent, so it may also be implicitly not “measurable” by standard physics energy approaches [12].

- F. If consciousness is related to quantum-like mechanisms, then perhaps consciousness could directly interact with a quantum experiment. This is similar to random event generator PK experiments, except use quantum states [13]. Things to potentially observe would be the coherence or decoherence time changes, additional quantum noise, or change in quantum statistics influenced by conscious intent [14].
- G. Any choice has an information theoretic basis. Any human choice due to volitional free will must represent an internal state space change. This internal choice could cause a physical action and suggests an information-to-energy mechanism. This is similar to bits impacting black holes.
- H. Causality is a temporal concept so pre-time or non-time domains alternatively suggests a bidirectional information “constraint” system as basis for physical laws, rather than one-way causal relationships.
- I. Memory and communication are conceptually the same, since each requires transport of information thru “space-time”. Communication is primarily associated with “space” transport and memory associated with “time” transport even though spacetime is inseparable. Notions of pre-time and pre-space information encoding would suggest a unity of both terms into one.

Other informational ideas can be recast into this non-energy, pre-space, pretime, information-encoding framework for internal, subjective states in future research.

4 CONCLUSIONS

Quantum states and subjective states of consciousness are both are very real, implicitly **not** observable, but still exhibit informational characteristics. Standard energy dominated communications theory is not complete to deal with these informational domains, especially since they exist outside normal spacetime. Non-energy information encoding theories and mathematics must be developed to act as the informational accounting systems for these internal domains. Excluding information theoretic notions (and consciousness) from unified quantum gravity theories will most likely give incomplete solutions.

5 REFERENCES

- [1] M. Schiffer, 1993, "The Interplay between Gravitational and Information Theory", Proceedings of the Workshop on Physics and Computation, PhysComp92, IEEE Computer Society Press, Los Alamitos, CA.
- [2] L. Kaufman and H. P. Noyes, 1996, "Discrete Physics and the Derivation of the Electromagnetism from the Formalism of Quantum Mechanics", Proc. of the Royal Society, A 452, pp. 81-95.

- [3] R. Landauer, 1993, "Information is Physical", PhysComp92, Proceedings of the Workshop on Physics and Computation, PhysComp92, IEEE Computer Society Press, Los Alamitos, CA.
- [4] J. Wheeler. 1989. "It From Bit", Proceedings 3rd International Symposium on Foundations of Quantum Mechanics, Tokyo.
- [5] Ken Wilber, "A Brief History of Everything".
- [6] D. Matzke, 1996, "Information is Protophysical", PhysComp96, New England Complex systems Institute, Boston, MA, pp. 223-225.
- [7] Michio Kaku, 1994. "Hyperspace, A Scientific Odyssey Through Parallel Universes, Time Warps, and the Tenth Dimension". Oxford University Press
- [8] Pentti Kanerva, 1988, "Sparse Distributed Memory", MIT press, Cambridge, MA.
- [9] P. W. Shor, 1994, "Algorithms for Quantum Computation: Discrete Logarithms and Factoring", In Proceedings of 35th Annual Symposium on the Foundations of Computer Science, IEEE Computer Society Press, Los Alamitos, CA, p 124.
- [10] S.Hameroff, 1998, "Panexperientialism and physical reality", Tucson III, University of Arizona, Consciousness Research Abstracts, Journal of Consciousness Studies.
- [11] W. Harman, 1994, "Toward a Science of Consciousness: Addressing two Central Questions", Toward a Science of Consciousness, The First Tucson Discussions and Debates, MIT Press.

[12] Y. Khronos, D. Chen, D. Matzke, V. Porter, 1996, "Direct Conscious Awareness of Chi: Case Study", Presented at Towards a Science of Consciousness, Tucson II, University of Arizona, Consciousness Research Abstracts, Journal of Consciousness Studies, pg. 148.

[13] G.E.R.Schwartz, L.G.S.Russek, ZSSheL. Z.Y.X.Song, Y.Xin, 1998, "Anomalous organization of random events during an international Qigong meeting: Evidence for group consciousness or accumulated Qi fields?", Tucson III, University of Arizona, Consciousness Research Abstracts, Journal of Consciousness Studies.

[14] D. Matzke, 1996, "Prediction: Future Electronic Systems Will be Disrupted due to Consciousness", Presented at Towards a Science of Consciousness, Tucson II, University of Arizona, Consciousness Research Abstracts, Journal of Consciousness Studies, pg. 161-162.

EXPERIENCING THE MEDITATIVE STATE

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At the meeting I led the group through a set of (typical) instructions intended to induce the practitioner into the meditative state, or, as the Tibetans call it, *natural mind*, and also a state of *calm abiding*.

This state is a state of *being*, as opposed to the state of *doing* that is characteristic of our usual waking consciousness. Hence any mental activity that relates to *doing*, and hence to the passage of *time* that necessarily accompanies things done, is to be banished: thoughts of the past, plans for the future, and the like. Once this is accomplished (and for most people it takes daily practice), the next stage is to rid one's mental table of thoughts and images, and content in general. The general goal is to be entirely *expectant upon one's perception, while remaining free of expectations*, to combine profound relaxation with a pure and direct (but undirected) awareness.

This state is the state of natural mind, a state that abides calmly in the present, simply awaiting whatever happens next. Those that connect the experience of consciousness to thoughts and thinking are contradicted: in the state of natural mind one is *quite* conscious. I think it is also important to understand that not only is this state natural, it is a state one has been in

many times before: for much of one's childhood, in intense play, in skilful and expressive performance (musical, dramatic, athletic, and the like), in the centre of laughter (and a sneeze), in orgasm, etc. It is just that, as our ego-consciousness gained dominance, we have literally *forgotten* both the state and how to reach it. Thus it is that Jesus of Nazareth said that one must be as a child if one is to enter the kingdom of heaven.

Some of the experiences mentioned above are quite intense. For better or worse, this seems rarely to be the case when one is directly angling after the state! So there is no reason to be fearful, and indeed, one should avoid methods (e.g. rebirthing, for some people) that induce fear: there are problems enough in teaching and maintaining the state. On the other hand, the ego knows deep down that it's not really the whole story, but at the same time can (by its very nature) comprehend neither how this can be, nor how one can exit ego-consciousness except by death. So a little niggling unease, emanating from the ego, is to be expected, but disappears gradually as it learns that there is truly nothing to fear.

Long term cultivation of natural mind combined with appropriate methods for deepening the state lead to an ultimate state, wherein mind becomes the font itself of perception. In my introductory comments, I identified this state with that of being the [event] window itself, rather than the perceptions that come through it. The event window mechanism, described in the reference below, is namely that of Void, wherein the role of arithmetic zero is explicit. All mental events and associated content emanate from this source.

I conclude (this retrospective version of) my introductory comments with the instruction I gave. As noted earlier, it is fairly typical for an introductory practice, and can be used daily if you so desire. But if you find that it whets an appetite for more, do seek expert instruction. In this regard, the Tibetan tradition is, in my opinion, the most advanced and sophisticated, and *dzogchen* the practice one should seek to learn; neither this practice nor meditation generally is incompatible with whatever religious beliefs you may hold. The Tibetans themselves for the most part do not require a *religious* mind-set of the student - Buddhism being fundamentally empirical - but the crowds of acolytes that surround them often feel otherwise, sometimes making entrance to serious circles cumbersome.

1. Sit *comfortably* - in a chair with a straight back, feet flat on the floor, and thighs parallel thereto; or cross-legged on a low cushion, knees on the floor. It is important that the spine be erect, with the small of the back tipped slightly forward; and that one is not in a draft.
2. If you wish a regular practice, mornings are best --after bathing, and maybe a cup of tea or coffee, but before any actual meal. 20-30 minutes is sufficient for progress.
3. Music or other "sound" is not necessary, and (imho) is to be avoided unless you need it to drown unavoidable environment noise (e.g. traffic).
4. Close your eyes. Relax your eyes, eyebrows, lips, ears, tongue, jaw.
[Repeat whenever you notice you've tensed up again.]

5. Notice your breathing. Drive your breathing with your belly (diaphragm) rather than your shoulders and chest.

6. Imagine yourself to be in an equilateral triangle whose tip is a point roughly your forearm's length above the top of your head (your "Identity" point), and whose base passes just beneath you, and extends appropriately to either side. If you like, mentally trace the outline of the triangle: from the Id point down to the rightmost corner (optionally, with a blue line or swath), across (earthy red) to the leftmost corner, then back up (spring green) to the Id point. [The triangle form is very stabilizing, and can be renewed whenever you feel it would be helpful. Distortions in your sense of the triangle are normal, and have semantic content. For example, problems with getting the baseline and/or R and L corners all the way down to where they should be relate to grounding.]

7. Place the palms of your hands together in front of you, forearms roughly horizontal. Hold for a few minutes (or throughout, if you like). Otherwise, the thumb and the tip of the forefinger should be touching, hands on knees or thighs, or gathered in front of you. Both of these are stabilizing postures (*mudras*).

8. *Imagine* a line running from the Id point down through the centre of your head, along the inner side of your spine, to the centre of your crotch (trust your sensation to give you the location of this point (*root*), ditto for Id point), bisecting the triangle. Optionally, to increase intensity, you can mentally trace the line from the root to the Id point *and back*, even several times; but be aware that the Id point is

extremely powerful, so do *not* overdo this, nor experiment in any way with it.

9. Focus on your breathing, to the way the air flows in and out of your nostrils, to the movement of your diaphragm,' and all other sensations associated herewith. In this way, distract your awareness from its usual focus on past events and future plans, thoughts, images, and all other "content".
10. While holding the focus on your breathing, imagine the outline of your body. Keep breathing *through* whatever happens, through pain or tension, fear or surprise, whatever. Inevitably, your mind will be caught up in new content. When you discover this, back up in these instructions to a useful point, and begin anew.
11. The first few times you do this, pay particular attention to the changes that occur in your subjective awareness with each step. This will help to clarify what the state you are trying to attain is like. Grasping precisely this is *the* problem for many people. A good analogy is the feeling of balancing on a bicycle - recall how you flailed around, and how unhelpful all instruction seemed, until finally you just "felt" it, whereafter it was obvious. This is similar in many respects.

REFERENCE

Manthey, Michael. A Combinatorial Bit Bang Leading to Quaternions. In Proceedings of ANPA 20, K. Bowden, Ed.

The Physical Significance of the Factor 2

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Abstract. A numerical factor 2 or $\frac{1}{2}$ occurs in many physics equations, classical, relativistic or quantum, and also in some aspects of mathematics. Analysis of this factor suggests that, in all significant examples, it has a common origin, a fact which has profound implications for the philosophical foundations of both physics and mathematics, and the relationship between them. It may be tracked down, ultimately, to the principle of duality, in which both physics and mathematics structure themselves by trying to avoid creating 'something' from nothing.

GEOMETRY AND KINEMATICS

We probably first come across the factor 2 in the formula for the area of a triangle, $\frac{1}{2} \times$ length of base \times perpendicular height. In the right-angled triangle, it is created by bisecting a rectangle along a diagonal. If this is now taken as representing a straight-line graph, of, say, velocity (v) against time (t), under uniform acceleration, the area under the graph becomes the distance travelled, $\frac{1}{2} vt$. By comparison, for an object travelling at steady speed v throughout the same time interval t , the distance travelled is the area of the rectangle under the horizontal straight line representing steady v , that is, vt . The factor 2, in this case, distinguishes between steady conditions and steadily *changing* conditions.

Starting from an initial velocity u , and supposing the same uniform acceleration, we obtain the 'mean speed theorem', in which the total distance travelled under uniform acceleration equals the product of the mean speed and the time: $s = \frac{1}{2} (u + v) t$. If we additionally define uniform acceleration as $a = (v - u) / t$, we obtain the well-known equation for uniformly accelerated motion: $v^2 = u^2 + 2as$, which becomes $v^2 = 2as$, when $u = 0$. If we now apply this to a body of mass m , acted on by a uniform force $F = ma$, we find the work done over distance s is equal to the kinetic energy gained

$$Fs = mas = \frac{mv^2}{2} - \frac{mu^2}{2},$$

which reduces to $\frac{1}{2} mv^2$ if we start at zero speed. Using $p = mv$ to represent momentum, it is convenient also to express this formula in the form $p^2 / 2m$. It is easy, of course, to show that this formula applies additionally to the case of nonuniformly accelerated motion, using a simple integration of force (dp / dt) over displacement:

$$\int \frac{dp}{dt} ds = \int mv dv = \frac{mv^2}{2}.$$

In principle, however, we see that a steady increase of velocity from 0 to v requires an averaging out which halves the values of significant dynamical quantities obtained under steady-state conditions.

KINETIC AND POTENTIAL ENERGY

The same factor makes its appearance, in precisely the same way, in molecular thermodynamics, quantum theory and relativity. Its significance here is that it relates the continuous aspect of physics to the discrete, and, since these aspects are required in the description of any physical system, the factor acquires a universal relevance. An obvious classical manifestation is the fact that *two* types of conservation of energy equation are commonly used in physics. Potential energy equations represent steady-state conditions, when there is no overall change in the energy distribution; kinetic energy equations apply when there is a redistribution of energy within a system though the energy remains conserved overall. Typically, we apply the potential energy equation to the case of a planet in a regular gravitational orbit. So, the force equation

$$\frac{mv^2}{r} = -\frac{GMm}{r^2}$$

leads to an equivalent potential energy relation

$$mv^2 = -\frac{GMm}{r}$$

However, the changing conditions involved in the escape of a body of mass m from a gravitational field require a kinetic energy equation of the form

$$\frac{mv^2}{2} = \frac{GMm}{r}$$

Numerically, in such cases, the potential energy term is twice the value of the kinetic, and we recognise that this is a special case of the virial theorem, according to which, in a conservative system governed by force terms inversely proportional to power n of the distance, or potential energy terms inversely proportional to power $n - 1$, the time-averaged kinetic and potential energies, \bar{T} and \bar{V} , are related by the formula:

$$\bar{T} = \frac{(1-n)}{2} \bar{V}$$

For the two special cases, of constant force and inverse-square-law force, \bar{V} is numerically equal to $2\bar{T}$. Such forces, in fact, are overwhelmingly predominant in nature, because they are a natural consequence of three-dimensional space, and this may well be related to the geometric origin of the factor 2 in such formulae as that for the area of a triangle.

KINETIC THEORY OF GASES

Though the potential and kinetic energy equations may, at first sight, appear to be contradictory expressions of the general principle of the conservation of energy, they can be easily reconciled if we consider the kinetic energy relation to be concerned with the action side of Newton's third law, while the potential energy relation concerns both action and reaction. We can give many physical illustrations. An old proof of Newton's of the mv^2 / r law for centripetal force, and hence of the formula mv^2 for orbital potential energy, had the satellite object being 'reflected' off the circle of the orbit, in a polygon with an increasing number of sides, which, in the limiting case, becomes a circle. The imagined physical reflection, by doubling the momentum through action and reaction, then produces the potential energy, rather than kinetic, energy formula.

Precisely the same principle applies in the derivation of Boyle's law, from what we often call the 'kinetic theory of gases'. Here, a real reflection of the ideal gas molecules off the walls of the container produces the momentum doubling, which indicates steady-state conditions, though it is immediately removed by the fact that we have to calculate the average time between collisions ($t = 2a / v$) as the time taken to travel *twice* the length of the container (a). The average force then becomes the momentum change / time = $2mv / t = mv^2 / a$, and the pressure due to one molecule in a cubical container of side a becomes mv^2 / a^3 , or mv^2 / V (volume), leading for n molecules to the direct pressure-density relationship, which we call Boyle's law. The kinetic behaviour of the ideal gas molecules is actually irrelevant to the derivation, since the system describes a steady-state dynamics with positions of molecules constant on a time-average. Taking into account the three dimensions between which the velocity is distributed, the ratio of pressure and density (P / ρ) is derived from the *potential energy* term mv^2 for each molecule and is equal to one third of the average of the squared velocity, or $\bar{c}^2 / 3$. So, the relationship could have been derived (as was done by Newton) using a mathematical model in which the molecule positions remained fixed.

The kinetic behaviour only becomes significant when we introduce temperature as a measure of the average kinetic energy of the molecules of the gas. There is, however, no 'derivation' involved here, because temperature is not defined independently of this kinetic energy, and we are obliged to provide this definition by an *explicit* use of the virial theorem, to find the otherwise *unknown* average kinetic energy from the *known* potential energy. Assuming that the potential energy of each ideal gas molecule is kT for each degree of freedom, and, in total, $3kT$, and taking the pressure law as equivalent to a dynamical system involving a constant force, we apply the virial theorem to obtain the kinetic energy expression ($3kT / 2$) for each of these molecules.

PHOTONS AND RADIATION PRESSURE

Photons, unlike material particles, are relativistic objects, so we might expect that the expressions for photon gases would be different in some respect from those for material gases. In fact, they are almost identical, as the radiation pressure of a photon gas within a fixed enclosure is one third of the energy density of radiation, that is:

$$P = \frac{1}{3} \rho c^2 .$$

The photon, as a 'gas' component, thus behaves in exactly the same way as a material particle, and, because the system is in steady state, the energy term mc^2 behaves as *potential*, not kinetic, energy, exactly as its form would suggest, with no mysterious 'relativistic factor' at work, as suggested by some authors. The photons are reflected off the walls of the container in the same way as the material gas molecules, although this time we can also consider the process as involving absorption and re-emission.

The whole reason for Einstein's introduction of $E = mc^2$ to represent the total energy of both photons and material particles was to preserve the *classical* laws of conservation of mass and conservation of energy. The total energy equation, unlike the *change of energy* formula $\Delta E = \Delta mc^2$, cannot be derived, by deductive means, from the postulates of relativity; it depends entirely on the choice of an integration constant in the relativistic expression for rate of energy change:

$$\frac{dT}{dt} = \mathbf{F} \cdot \mathbf{v} .$$

No problem arises if we recognise that mc^2 has a classical, *as well as relativistic*, meaning. Like many other significant results (the Schwarzschild radius, the equations for the expanding universe, the gravitational redshift, the spin of the electron), the expression does not arise from the theory of relativity itself but is a more fundamental truth which that theory has uncovered.

It would be extraordinary, in fact, if relativistic conditions should somehow conspire exactly to halve or double significant classical quantities. Relativistic factors are typically of the form $\gamma = (1 - v^2 / c^2)^{-1/2}$, implying some gradual change when $v \rightarrow c$, and it makes no physical sense to suppose that the transition involves discrete integers. $\Delta E = \Delta mc^2$ is a relativistic equation because it incorporates the γ factor in the Δm term, but $E = mc^2$ is not, and, for photons at least, the effects which depend only on $E = mc^2$ and not specifically on the 4-vector combination of space and time can be derived by classical approaches entirely independent of any concept of relativity. Examples of this can be found in calculations based on the classical corpuscular theory of light dating back to the seventeenth, eighteenth and nineteenth centuries, and are still used for practical purposes at the present day. We may mention, for example, Newton's calculation of atmospheric refraction in 1694, and his application

of the formula for the velocity of waves in a medium to an optical aether in Query 21 of the *Opticks*. Essentially, Newton's formula,

$$c = (E / \rho)^{1/2}$$

where E is elasticity or pressure and ρ density, is an expression of the fact that the potential energy of the system of light corpuscles, or the aether that acts upon them, is equal to the work done at constant pressure as a product of pressure and volume. Newton's elasticity of the aether is essentially the same as the modern energy density of radiation (ρc^2), which is related by Maxwell's classical formula of 1873 to the radiation pressure. Light necessarily gives a 'correct' result for such a calculation when travelling through a vacuum, because there is no source of dissipation, and the virial relation takes on its ideal form.

PHOTONS IN A GRAVITATIONAL FIELD

There are many further relations between photon and material particle dynamics, which will be significant to us. Although light in free space has velocity c , and, therefore, no rest mass or kinetic energy, *as soon as you apply a gravitational field*, the light 'slows down', and, at least *behaves* as though it can be treated as a particle with kinetic energy *in the field*. The same, of course, applies to photons in a plasma, a system which has often been used as an analogy to the Higgs mechanism for acquiring mass in particle physics. An example directly applicable to photons is the use of the standard Newtonian escape velocity (or kinetic energy) equation

$$\frac{mv^2}{2} = \frac{GMm}{r}$$

to derive the Schwarzschild limit for a black hole, by purely classical means, as was done more than once in the eighteenth century. Assuming $v \rightarrow c$, we derive

$$r = \frac{2GM}{c^2}$$

with *no transition to a 'relativistic' value*.

A classic case of applying such a kinetic energy-type equation to light, is the derivation of the double gravitational bending, an effect often thought to be derivable only from the general relativistic field equations. We have been assured repeatedly, since Eddington's measurement of 1919, that the double bending is a relativistic effect, and that 'Newtonian' calculations, using the principle of equivalence, yield only half the correct value, although several authors have shown that the effect can be derived also from special relativity.

The 'Newtonian' calculation, we are told, originating with Soldner in 1801, starts from the potential energy equation (modified for a hyperbolic orbit), according to the expression:

$$mc^2 = \frac{GMm(e-1)}{r},$$

with e taken as the eccentricity of the hyperbolic orbit. Since $1 \ll e$, the half-angle deflection becomes

$$\frac{1}{e} = \frac{GM}{c^2 r},$$

and the full angle deflection (in and out of the gravitational field)

$$\frac{2}{e} = \frac{2GM}{c^2 r}.$$

This is only half the general relativistic value. However, Soldner actually used the kinetic energy equation,

$$\frac{mc^2}{2} = \frac{GMm(e-1)}{r},$$

on the basis of Laplace's prior use of it for calculating the black hole radius, and he would have obtained the 'correct' total deflection if he had used the double angle in calculating his integral! Soldner's procedure was surely the correct one, for the case he was examining was that of an orbit in the process of formation (the reverse, in effect, of Laplace's escape velocity), and not of an orbit in steady state.

That a purely classical calculation of the light-bending is possible should not surprise us. Energy, in relativity, is, after all, *defined* to be consistent with its classical value in the case of a particle with no material component; and so relativity theory should not produce different energy equations to classical physics for light photons; it merely corrects our naïve understanding of what are steady-state and what are changing conditions. Of course, in the case of photons, we never see a material kinetic energy directly, the total energy balance means that it must be possible to treat it as though it does exist when the particle is 'slowed down' by a field.

There are many cases where a 'relativistic' correction (either special or general) is presumed to 'cause' the doubling of a physical effect, but such examples, are not illustrations of the fact that the calculation of the doubling has to be done relativistically, but that relativity provides one way of incorporating the effect of changing conditions if we begin with the potential, rather than the kinetic, energy equation. In the case of gravitational bending, the potential energy equation typically produces the effect of gravitational redshift, or time dilation, while relativity adds the corresponding length contraction. So authors have variously argued for the redshift being 'Newtonian' while the length-contraction or 'space-warping' is relativistic, or for the length contraction being Newtonian while the redshift is relativistic. Claims have also been made that the 'Newtonian' effect has to be added to that produced by

the Einstein calculation of 1911, based on the equivalence principle (which also obtained only half of the correct value), or that the two effects are the same, and have to be supplemented by a 'true' relativistic effect, like the Thomas precession. All of these arguments are correct, but none is fundamental. The true reason is the choice of classical energy equation. If the potential energy equation is used where the kinetic energy equation is appropriate, then correct physical reasons can be found for almost any additional term which doubles the effect predicted. Even special relativity is only an alternative approach to a calculation that must also be valid classically, and the same applies to the even more famous case of the planetary perihelion precession.

THE GYROMAGNETIC RATIO OF THE ELECTRON

It has also been assumed that relativity is needed to explain the anomalous magnetic moment or, equivalently, the gyromagnetic ratio of a Bohr electron acquiring energy in a magnetic field. 'Classical' reasoning, we assured, would show the energy acquired by an electron changing its angular frequency from ω_0 to ω in a magnetic field \mathbf{B} to be of the form

$$m(\omega^2 - \omega_0^2) = e\omega_0 r B ,$$

leading, after factorization of $(\omega^2 - \omega_0^2)$, to an angular frequency change

$$\Delta\omega = \frac{eB}{2mr} .$$

However, a relativistic effect (the Thomas precession, again) ensures that the classical $e\omega_0 r B$ is replaced by $2e\omega_0 r B$, leading to

$$\Delta\omega = \frac{eB}{mr} .$$

But, once again, relativistic and classical treatments coincide when, as with the light bending example, the *kinetic* energy equation is recognised as the one applied to changing conditions, *at the instant we 'switch on' the field*. Then, we automatically write

$$\frac{1}{2} m(\omega^2 - \omega_0^2) = e\omega_0 r B ,$$

which is no more, in principle, than the equation of motion for uniform acceleration

$$v^2 - u^2 = 2as .$$

So, the Thomas precession or 'relativistic' correction is needed if we begin with the potential energy equation applicable to a steady state, but not if we apply the kinetic energy used for changing conditions.

ELECTRON SPIN

The gyromagnetic ratio is, of course, produced ultimately by the electron spin, which is one of the most famous cases of the factor $\frac{1}{2}$. Traditionally, this is derived from the relativistic Dirac equation by consideration of the commutator

$$[\hat{\sigma}, \mathcal{H}] = [\hat{\sigma}, i\gamma_0\boldsymbol{\gamma}\cdot\mathbf{p} + \gamma_0m].$$

Purely formal reasoning shows that this reduces to $2\gamma_0\boldsymbol{\gamma} \times \mathbf{p}$, or in our multivariate vector terminology (equivalent to Pauli matrices), to $2ij\mathbf{1} \times \mathbf{p}$. The significant thing here is that the factor 2 emerges from the anticommuting properties of the vector operators in an equation such as

$$[\hat{\sigma}, \mathcal{H}] = 2j (ijp_2 + ikp_3 + jip_1 + jkp_3 + kip_1 + kjp_2).$$

Ultimately, this leads to

$$[\mathbf{L} + \hat{\sigma} / 2, \mathcal{H}] = 0.$$

where \mathbf{L} is the orbital angular momentum, from which we find that $(\mathbf{L} + \hat{\sigma} / 2)$ is a constant of the motion.

There is, however, a way of deriving the same result (at least in its manifestation in the presence of a magnetic field) from the Schrödinger equation, which can easily be shown to be a nonrelativistic limit to the bispinor form of the Dirac equation. In principle, this should mean that the spin $\frac{1}{2}$ term that arises from the Dirac equation has nothing to do with the fact that the equation is relativistic, but is a result of the fundamentally multivariate nature of its use of the momentum operator, as the formal derivation from the Dirac equation would suggest.

It is significant that the standard derivation of the Schrödinger equation begins with the classical expression for kinetic energy, $p^2 / 2m = mv^2 / 2$.

$$T = (E - V) = \frac{p^2}{2m},$$

followed by substitution of the quantum operators $E = i\partial / \partial t$ and $\mathbf{p} = -i\nabla$, acting on the wavefunction ψ , for the corresponding classical terms, to give:

$$(E - V)\psi = -\frac{1}{2m}\nabla^2\psi$$

or

$$i\frac{\partial\psi}{\partial t} - V\psi = -\frac{1}{2m}\nabla^2\psi,$$

in the time-varying case. Various authors [e.g. Gough, 1990] have shown that, using a multivariate operator, $\mathbf{p} = -i\nabla + e\mathbf{A}$, in the absence of scalar potential V , we derive:

$$2mE\psi = (-i\nabla + e\mathbf{A})(-i\nabla + e\mathbf{A})\psi$$

leading ultimately, by a relatively easy derivation, to

$$2mE\psi = (-i\nabla + e\mathbf{A})(-i\nabla + e\mathbf{A})\psi + 2m\mu\cdot\mathbf{B},$$

which is the conventional form of the Schrödinger equation in a magnetic field for spin up, supplied by the usual *ad hoc* addition of Pauli matrices, and a similar expression may be derived from the spin down state. The 2 in the expression $2m\mu\cdot\mathbf{B}$ arises from the anticommuting properties of the multivariate vectors. In effect, spin is purely a property of the multivariate nature of the \mathbf{p} term, and has nothing to do with whether the equation used is relativistic or not. (This is equivalent to stating the well-known fact that the 4π rotation involved in spin is purely a property of the rotation group.) We also see that the factor 2 is both introduced with the transition in the Schrödinger equation from the classical kinetic energy term, and, at the same time, produced by the anticommuting nature of the momentum operator. It is precisely because the Schrödinger equation is derived via a kinetic energy term that this factor enters into the expression for the spin, and this process is essentially the same as the process which, through the anticommuting quantities of the Dirac equation, makes $(L + \hat{\mathbf{G}} / 2)$ a constant of the motion.

THE HARMONIC OSCILLATOR AND HEISENBERG UNCERTAINTY

The Schrödinger equation also allows an easy calculation of the eigenvalues of the quantum harmonic oscillator, in which a *varying* potential energy term, $\frac{1}{2} m\omega^2 x^2$, taken from the classical kinetic energy term $\frac{1}{2} mv^2$, is added to the Hamiltonian. A formal derivation is hardly necessary to show that the $\frac{1}{2}$ in the expression for the ground state or 'zero-point' energy,

$$E_0 = \frac{\hbar\omega}{2},$$

carries over directly from this original introduction.

Anticommuting operators also introduce the factor 2 in the Heisenberg uncertainty relation for the same reason as they do in the treatment of electron spin, and the Heisenberg term also relates directly to the zero-point energy derived from the kinetic energy of the harmonic oscillator. The formal derivation of the Heisenberg assumes a state represented by a state vector ψ which is an eigenvector of the operator P . If Q is an operator which anticommutes with P , we derive

$$(\Delta p)(\Delta q) \geq (1/2) [P, Q] \geq \hbar / 2$$

where the factor 2 in comes from the noncommutation of the p operator.

BOSONS AND FERMIONS

The origin of the factor 2 in the spin states of fermions and bosons, is, once again, the virial relation between kinetic and potential energies. In our reformulation of the Dirac equation for fermions, we take the classical relativistic energy-momentum conservation equation:

$$E^2 - p^2 c^2 - m_0^2 c^4 = 0 ,$$

where m_0 is rest mass, and factorize using our quaternion-multivariate-4-vector operators to give:

$$(\pm kE \pm ii \mathbf{p} + ij m_0) (\pm kE \pm ii \mathbf{p} + ij m_0) = 0 .$$

We then apply the Correspondence Principle to obtain

$$\left(\pm ik \frac{\partial}{\partial t} \pm i \nabla + ij m_0 \right) \psi = 0 ,$$

where

$$\psi = (\pm kE \pm ii \mathbf{p} + ij m_0) e^{-i(Et - \mathbf{p} \cdot \mathbf{r})} .$$

for a fermion. We can proceed to show that a spin 1 boson wavefunction (incorporating fermion-antifermion combination) is the sum of

$$\begin{aligned} & (kE + ii \mathbf{p} + ij m_0) (-kE + ii \mathbf{p} + ij m_0) \\ & (kE - ii \mathbf{p} + ij m_0) (-kE - ii \mathbf{p} + ij m_0) \\ & (-kE + ii \mathbf{p} + ij m_0) (kE + ii \mathbf{p} + ij m_0) \\ & (-kE - ii \mathbf{p} + ij m_0) (kE - ii \mathbf{p} + ij m_0) \end{aligned}$$

while a spin 0 boson reverses the signs of \mathbf{p} in the second column. The fermion wavefunction is effectively a nilpotent or square root of 0, and the boson wavefunction a product of two nilpotents (each not nilpotent to the other).

From both Dirac and Schrödinger equations, effectively describing kinetic energy states, we see that fermions have half-integral spins. The Klein-Gordon equation, which applies to bosons, however, is the potential energy equation, based on $E = mc^2$, where m is now the 'relativistic', rather than the rest mass, and bosons derive their integral spin values from the fact that the energy term in this equation contains unit values of the mass m . Here, we quantize the classical relativistic energy-momentum equation directly, to obtain

$$\frac{\partial^2 \psi}{\partial t^2} - \nabla^2 \psi = m^2 \psi ,$$

in units where $\hbar = c = 1$.

The difference between the fermion and boson cases is that we use the kinetic energy relation when we consider a particle as an object in itself, described by a rest mass m_0 , undergoing a continuous change; and the potential energy relation when we consider a particle within its 'environment', with 'relativistic mass', in an equilibrium state requiring a discrete transition for any change. Kinetic energy is associated with rest mass, because it cannot be defined without it – light 'slowing down' in a gravitational field or condensed matter is effectively equivalent to adopting a rest mass. Potential energy is associated with 'relativistic' mass because the latter is *defined* through a potential energy-type term ($E = mc^2$), light in free space being the extreme case, with no kinetic energy or rest mass, and 100 per cent potential energy or relativistic mass.

The description is also related to the halving process that occurs, for a material particle, when we expand its relativistic mass-energy term (mc^2) to find its kinetic energy ($\frac{1}{2}mv^2$). So we can take the relativistic energy conservation equation

$$E - mc^2 = E^2 - p^2c^2 - m_0^2c^4 = 0 .$$

as a 'relativistic' mass or potential energy equation, treating at one go the particle interacting with its environment, and proceed to quantize to a Klein-Gordon equation, with integral spin. Or, we can separate out the kinetic energy term using the rest mass m_0 , and take the square root of

$$E^2 = m_0^2c^4 \left(1 - \frac{v^2}{c^2}\right)^{-1} ,$$

to obtain

$$E = m_0c^2 + \frac{m_0v^2}{2} + \dots$$

from which, as we have seen, we derive the Schrödinger equation, and spin $\frac{1}{2}$. The $\frac{1}{2}$ is, indeed, a statement of the act of square-rooting, which is precisely what happens when we split 0 into two nilpotents in the Dirac equation; the $\frac{1}{2}$ in the Schrödinger approximation is a manifestation of this which we can trace through the $\frac{1}{2}$ in the relativistic binomial approximation. The origin of the same factor in the derivation of spin from the Dirac equation, is seen in the behaviour of the anticommuting terms which result from the process of taking the nilpotent: the anticommuting and binomial factors have precisely the same origin.

ZERO POINT ENERGY AND RADIATION REACTION

The significance of the factor 2 in all our examples lies in the fact that it relates together two parallel but almost independent streams of physics: the continuous and the discontinuous. Expressions involving half units of \hbar represent an average or integrated increase from 0 to \hbar . The half-values are characteristic of the continuous option in physics, the integral ones of the discontinuous option. Schrödinger and Heisenberg are examples of these options; and yet another completely continuous

theory, electrodynamics, based on the existence of zero-point energy of value $\hbar\omega/2$, has developed as a rival to the purely discrete theory of the quantum with energy $\hbar\omega$.

The discrete and continuous options are not only possible, but actually *required* within a system. Each type of system has to incorporate the alternative option in some way. Schrödinger, for instance, has a continuous system based on $\frac{1}{2}\hbar$, but incorporates discreteness (based on \hbar) in the process of measurement – the so-called collapse of the wavefunction. Heisenberg, on the other hand, has a discrete system, based on \hbar , but incorporates continuity (and $\frac{1}{2}\hbar$) in the process of measurement – via the uncertainty principle and zero-point energy. Nature, it would seem, always manages to provide a route by which $\frac{1}{2}\hbar\omega$ in one context becomes $\hbar\omega$ in another. A characteristic example is black-body radiation, where the spontaneous emission of energy of value $\hbar\omega$ is produced by the combined effect of the $\frac{1}{2}\hbar\omega$ units of energy provided by both oscillators and zero-point field.

The $\frac{1}{2}h\nu$ for black body radiation appears in both the theories of Planck, of 1911, and of Einstein and Stern, of 1913. In quantum mechanics, as we have seen, the zero-point energy term is derived from the harmonic oscillator solution of the Schrödinger equation, while, in the Heisenberg formulation, it appears as a result of the $\frac{1}{2}h$ term involved in the uncertainty principle. While the derivation via Schrödinger shows the kinetic origins of the factor 2, the derivation from the uncertainty principle suggests an origin in continuum physics.

The $\frac{1}{2}\hbar\omega \rightarrow \hbar\omega$ transition for black body radiation can also be seen in terms of radiation reaction. Rather surprisingly, perhaps, this is again connected with the distinction between the relativistic and rest masses of an object. When we define a rest mass we effectively define an isolated object, and we cannot define *kinetic* energy in terms of anything but this rest mass. If, however, we take a *relativistic* mass, we are already incorporating the effects of the environment. In the case of a photon, which has no rest mass, and only a relativistic mass, the energy mc^2 behaves exactly like a classical potential energy term, for example as a component of a photon gas producing the radiation pressure $\rho c^2 / 3$. Action and reaction occurs in this instance because the doubling of the value of the energy term comes from the doubling of the momentum produced by the rebound of the photons from the walls of the container, or absorption and re-emission. The same thing happens with radiation reaction, which produces an otherwise ‘mysterious’ doubling of energy from $\frac{1}{2}h\nu$ to $h\nu$. In a different context, Feynman and Wheeler produce a doubling of the contribution of the retarded wave in electromagnetic theory, at the expense of the advanced wave, by assuming that the vacuum behaves as a perfect absorber and reradiator of radiation.

It seems that incorporating radiation reaction means that we are also incorporating the effect of Newton’s third law, as in the case of many other processes. However, many

of the same results, as in the parallel case of the anomalous magnetic moment of the electron, are also explained by special relativity. C. K. Whitney [2000] has argued that the correct result for the electron is obtained, without relativity, by treating the transmission of light as a two-step process involving absorption and emission, which, in our terms, is equivalent to incorporating action and reaction, or the potential energy equation, and, as we have seen, the same result follows classically by defining the potential energy at the moment the field is switched on. If, however, we use kinetic energy, or a one-step process, we also need relativity, because, once we introduce rest mass, we can no longer use classical equations. ('Relativistic mass' is, of course, specifically *designed* to preserve classical energy conservation!) The two-step process is analogous to the use of radiation reaction, so it follows, in principle, that a radiation reaction is equivalent to adding a relativistic 'correction' (such as the Thomas precession).

Whitney argues further that the two-step process removes those special relativistic paradoxes which involve apparent reciprocity, which is interesting, because special relativity, by including only one side of the calculation, effectively removes reciprocity, and so leads to such things as asymmetric ageing in the twin paradox. Similar arguments also apply to the idea that the problem lies in attempting to define a one-way speed of light that cannot be measured, because a two-way speed measurement of the speed of light also requires a two-step process.

'ENVIRONMENTAL REACTION'

We have already proposed that the factor 2 originates in the symmetry between the action of an object and the reaction of its environment. While a fermionic object on its own shows changing behaviour, requiring an integration which generates a factor $\frac{1}{2}$ in the kinetic energy term, and a sign change when it rotates through 2π , a conservative 'system' of object plus environment shows unchanging behaviour, requiring a potential energy term, which is twice the kinetic energy.

Taking 'environment' to apply to either material or vacuum, we can make sense, not only of the boson / fermion distinction and the spin 1 / $\frac{1}{2}$ division in a fundamental way, but also understand such concepts as supersymmetry, vacuum polarization, pair production, renormalization, *zitterbewegung*, and so on, because the halving of energy in 'isolating' the fermion from its vacuum or material 'environment' is the same process as mathematically square-rooting the quantum operator via the Dirac equation. Integral spins may be automatically produced from half-integral spin electrons using the Berry phase, and, by generalizing this kind of result to all possible environments, we may extend the principle in the direction of supersymmetry. In principle, we propose that energy principles determine that *all* fermions, in whatever circumstances, may be regarded either as isolated spin $\frac{1}{2}$ objects or as spin 1 objects in conjunction with some particular material or vacuum environment, or, indeed, the

'rest of the universe'.

In this context, fermions with spin $\frac{1}{2}$ become spin 1 particles when taken in conjunction with their environment, whatever that may be. The Jahn-Teller effect and Aharonov-Bohm effect are examples. Treated semi-classically, the Jahn-Teller effect couples the factors associated with the motions of the electronic and nuclear coordinates so that different parts of the total wave function change sign in a coordinated manner to preserve the single-valuedness of the total wave function.

In more general terms, we can consider a similar relationship existing between a fermion and 'the rest of the universe', the *total* wavefunction representing fermion plus 'rest of the universe' being necessarily single-valued, and automatically introducing the extra term known as the Berry phase. This duality occurs with the actual creation of the fermion state. Splitting away a fermion from a 'system' (or 'the universe'), we have to introduce a coupling as a mathematical description of the splitting. The reverse effect must also exist, with bosons of spin 0 or 1 couple to an 'environment' to produce fermion-like states. Perhaps the Higgs mechanism occurs in this way, but a more immediate possibility is the coupling of gluons to the quark-gluon plasma to deliver the total spin of $\frac{1}{2}$ or $\frac{3}{2}$ to a baryon.

Fermions and bosons, it would seem, always produce a 'reaction' within their environment, which couples them to the appropriate wavefunction-changing term, so that the potential / kinetic energy relation can be maintained at the same time as its opposite. The whole process of renormalization depends on an infinite chain of such couplings through the vacuum. The coupling of the vacuum to fermions generates 'boson-images' and vice versa.

RENORMALIZATION AND SUPERSYMMETRY

To understand the principle of renormalization, we need to use the nilpotent version of the Dirac wavefunction, which is, typically, $(kE + i\mathbf{p} + ijm)$ for a fermion and $(-kE + i\mathbf{p} + ijm)$ for an antifermion, these being abbreviated representations of 4-term bra and ket vectors, cycling through the full range of $\pm E$ and $\pm \mathbf{p}$ values. In terms of the 'environment' principle, a fermion generates an infinite series of interacting terms of the form:

$$\begin{aligned} &(kE + i\mathbf{p} + ijm) \\ &(kE + i\mathbf{p} + ijm)(-kE + i\mathbf{p} + ijm) \\ &(kE + i\mathbf{p} + ijm)(-kE + i\mathbf{p} + ijm)(kE + i\mathbf{p} + ijm) \\ &(kE + i\mathbf{p} + ijm)(-kE + i\mathbf{p} + ijm)(kE + i\mathbf{p} + ijm)(-kE + i\mathbf{p} + ijm), \text{ etc.} \end{aligned}$$

The $(kE + i\mathbf{p} + ijm)$ and $(-kE + i\mathbf{p} + ijm)$ vectors are an expression of the behaviour of the vacuum state, which acts like a 'mirror image' to the fermion. An expression such as

$$(kE + i\mathbf{p} + ijm) k (kE + i\mathbf{p} + ijm)$$

is part of an infinite regression of images of the form

$$(kE + i\mathbf{p} + ijm) k (kE + i\mathbf{p} + ijm) k (kE + i\mathbf{p} + ijm) k (kE + i\mathbf{p} + ijm) \dots$$

where the vacuum state depends on the operator that acts upon it, the vacuum state of $(kE + i\mathbf{p} + ijm)$, for example, becoming $k (kE + i\mathbf{p} + ijm)$. In addition,

$$(kE + i\mathbf{p} + ijm) k (kE + i\mathbf{p} + ijm) k (kE + i\mathbf{p} + ijm) k (kE + i\mathbf{p} + ijm) \dots$$

is the same as

$$(kE + i\mathbf{p} + ijm) (-kE + i\mathbf{p} + ijm) (kE + i\mathbf{p} + ijm) (-kE + i\mathbf{p} + ijm) \dots$$

It thus appears that the infinite series of creation acts by a fermion on vacuum is the mechanism for creating an infinite series of alternating boson and fermion states as required for supersymmetry and renormalization. The 'mirror imaging' process implies an infinite range of virtual E values in vacuum adding up to a single finite value, exactly as in renormalisation, with equal numbers of boson and fermion loops cancelling through their opposite signs.

This fundamental relation also leads to the significant fact that the nilpotent wavefunctions, in principle, produce a kind of supersymmetry, with the supersymmetric partners not being so much realisable particles, as the couplings of the fermions and bosons to vacuum states. The nilpotent operators defined for fermion wavefunctions are, in fact, also supersymmetry operators, which produce the supersymmetric partner in the particle itself. The Q generator for supersymmetry is simply the term $(kE + i\mathbf{p} + ijm)$, and its Hermitian conjugate Q^\dagger is $(-kE + i\mathbf{p} + ijm)$. Multiplying by $(kE + i\mathbf{p} + ijm)$ converts bosons to fermions, or antifermions to bosons (the \mathbf{p} can, of course, be + or -). Multiplying by $(-kE + i\mathbf{p} + ijm)$ produces the reverse conversion of bosons to antifermions, or fermions to bosons.

In this context, while the spin $\frac{1}{2}$ state is that of the isolated fermion, and due to kinetic energy, implying continuous variation, unit spin comes from the potential energy of a stable state, and represents either a boson with two nilpotents (which are not nilpotent to each other), or a bosonic-type state produced by a fermion interacting with its material environment or vacuum, and, as a consequence, manifesting Berry phase, Aharonov-Bohm effect, Jahn-Teller effect, Thomas precession, relativistic

correction, radiation reaction, quantum Hall effect, Cooper pairing, *zitterbewegung*, or whatever else is needed to produce the ‘conjugate’ environmental spin state. The isolated fermion thus represents the action half of Newton’s third law, while in the case of the fermion interacting with its environment, it is the action and reaction pair. The existence of a ‘supersymmetric’ partner seemingly comes from the duality represented by the choice of fermion or fermion plus environment.

THE AHARONOV-BOHM EFFECT

A consideration of the Aharonov-Bohm effect suggests that it may lead to a more profound understanding of the meaning of the factor 2 in fundamental physics. In this effect, electron interference fringes, produced by a Young’s slit arrangement, are shifted by half a wavelength in the presence of a solenoid whose magnetic field, being internal, does not interact with the electron but whose vector potential does. The half-wavelength shift turns out to be a feature of the topology of the space surrounding the discrete flux-lines of the solenoid, which is not *simply-connected*, and cannot be deformed continuously down to a point. Effectively, the half-wavelength shift, or equivalent acquisition by the electron of a half-wavelength Berry phase, implies that an electron path between source and slit, round the solenoid involves a *double-circuit* of the flux line (to achieve the same phase), and a path that goes round a circuit twice cannot be continuously deformed into a path which goes round once (as would be the case in a space without flux-lines).

The presence of the flux line is equivalent, as in the quantum Hall effect and fractional quantum Hall effect, to the extra fermionic $\frac{1}{2}$ -spin which is provided by the electron acting in step with the nucleus in the Jahn-Teller effect and makes the potential function single-valued, and the circuit for the complete system a single loop. It is particularly significant that the $U(1)$ (electromagnetic) group responsible for the fact that the vacuum space is not simply connected is isomorphic to the integers under addition. In effect, the spin- $\frac{1}{2}$, $\frac{1}{2}$ -wavelength-inducing nature of the fermionic state (in the case of either the electron or the flux line) is a product of discreteness in both the fermion (and its charge) and the space in which it acts. In principle, the very act of creating a discrete particle requires a splitting of the continuum vacuum into *two* discrete halves (as with the bisecting of the rectangular figure with which we started, or, in another context, the Dedekind cut, which defines the real numbers), or (relating the concept of discreteness to that of dimensionality) two square roots of 0. Mathematically, the identification of 1 as separate from 0 also implies that $1 + 1 = 2$, reflecting the fact that physics and mathematics have a common origin in the process of counting.

THE ORIGINS OF THE FACTOR 2

The numerical factor 2 has become an almost universal component of fundamental physics, playing a significant role in both quantum theory and relativity. Its origin and meaning can be explained in surprisingly simple terms, using relatively unsophisticated mathematics. We see it in terms of either action and reaction (A); commutation relations (C); absorption and emission (E); object and environment (O); relativity (R); the virial relation (V); or continuity and discontinuity (X). The overlap between many of these explanations in the case of individual phenomena demonstrates that they are really all part of the same overall process:

Kinematics				V	X
Gases	A			V	
Orbits	A			V	X
Radiation pressure	A	E		V	
Gravitational light deflection				R	V
Fermion / boson spin		C	O	R	V
Zero-point energy	A	C		V	X
Radiation reaction	A	E		R	V
SR paradoxes	A	E			

For example, kinetic energy variation may be thought of as continuous, but starting from a discrete state; potential energy variation, on the other hand, is a discrete variation, starting from a continuous state. Each creates the opposite in its variation from itself. Kinetic energy and potential energy create each other, in the same way as they are related by a numerical relationship. But kinetic energy also relates to a changing state, while potential energy is usually related to a fixed one. We can further consider the kinetic energy relation to be concerned with the action side of Newton's third law, while the potential energy relation concerns both action and reaction. The factor 2 is also an expression of the discreteness of both material particles (or charges) and the spaces between them, as opposed to the continuity of the vacuum in terms of energy. The same discreteness also implies (though more subtly) the concept of dimensionality, which is responsible for the noncommutativity of the momentum operator, as well as the discreteness of the division of rectangles into triangles.

In more general terms, the factor 2 is an expression of a fundamental duality in the whole concept of 'nature', a duality that is the result of trying to create something from nothing – the Aharonov-Bohm effect is a classic case, as is also the nilpotent algebra used for the fermion wavefunction. Fundamentally, physics does this when it sets up a probe to investigate an intrinsically uncharacterizable nature. Nature responds with symmetrical opposites to the characterization assumed by the probe, which, in its simplest form, is constituted by a discrete point in space. It has been demonstrated previously that this generates a symmetrical group of fundamental

parameters (space – the original probe – time, mass and charge – the combined response), which are defined by properties which split the parameters into three C_2 groupings, depending on whether they are conserved or nonconserved, real (or orderable) or imaginary (or nonorderable), continuous or discrete. Each of these divisions may be held responsible for a factor 2, for duality seems to be the necessary result of any attempt to create singularity.

space	real	nonconserved	countable (3-D)
time	imaginary	nonconserved	noncountable (1-D)
mass	real	conserved	noncountable (3-D)
charge	imaginary	conserved	countable (1-D)

Careful study of the factor 2 reveals that it is either the link between the continuous and discrete physical domains, or between the changing and the fixed, or the real and imaginary (orderable and nonorderable), the three dualities of the group, and, in every physical instance, between more than one of these.

While the continuous or discrete duality is obvious from the distinction between potential and kinetic energies, this distinction also incorporates the duality between conserved and nonconserved quantities, or fixed and changing conditions. The duality may also be expressed in terms of the distinction between space-like and time-like theories (for example, those of Heisenberg and Schrödinger, or of quantum mechanics and stochastic electrodynamics), which are not only distinguished by being discrete and continuous, but also by being real and imaginary. Though a single duality separates such theories, it is open to more than one interpretation because each pair of parameters is always separated by two distinct dualities.

THE STRUCTURE OF DUALITY

At the most profound level, as we have said, the factor 2 is an expression of the fundamental nature of duality, in physics, mathematics, and even ontology and epistemology. In simple terms, we can't define something without defining also what it is not, and we can't even characterize 'nature' or 'reality', even to the extent of saying whether it has an independent existence (is ontological) or is a product of our perception (is epistemological). It is possible to explain this on the basis that physics and mathematics are attempts at creating something from nothing. A 'theory of everything' needs first to be a 'theory of nothing'. We start from 'nothing' and we end with 'nothing', and duality is there to ensure that when we introduce 'something', we still end with nothing. But this does not mean that we cannot determine its structure. The fundamental duality operates in the most simple way possible.

We begin with the simplest possible symmetry group, C_2 , which we can describe in mathematical terms, by the use of the elements 1 and -1 , but which, physically, is just

anything and its opposite. Thus, as soon as we imagine 1 as different from 0, we also invoke its automatic negation, or the thing we describe as -1 . So, defining 1, at all, automatically creates a dual system, equivalent to requiring $1 + 1 = 2$, and generating the Peano idea of 'successor'. This seemingly leads to the creation of a natural (binary) numbering system, while avoiding the Gödel problem through the zero totality. (Work on this, and on programming aspects, is in progress with B. M. Diaz.) We also have no option but to relate -1 to 1 in some way other than defining their totality as 0, and the identity -1×-1 or $(-1)^2$ then becomes deeply significant in establishing that the relation between these elements is a *group* relationship, and that the 'multiplication' and 'squaring' of elements, in addition to identity and inversion, are operations which are fundamental to the principle of duality.

However, we require a dual, even for this C_2 group. We need to extend to four elements, to find an equivalent to $C_2 \times C_2$. The only way of extending the original group is if the two unknown elements acquire the characters that we describe by the symbols i and $-i$. Though the group of $1, -1, i, -i$ is not, of course, $C_2 \times C_2$, but C_4 , it contains the same *information* as $C_2 \times C_2$, for we can write this information in the form of the complex ordered pairs: $1, i; 1, -i; -1, i; -1, -i$, which is of the form $C_2 \times C_2$, and is the natural mathematical expression of complex numbers.

To dual again, we need to imagine another complexification, involving, new terms, which we could describe as j and $-j$. However, we now have the complication of the product ij , which must be a new term. The result of this process is the definition of the necessarily *cyclic* and noncommutative operators $i, -i, j, -j, k, -k$, which we describe as quaternions. The definition of the quaternion group Q_8 , with elements $1, -1, i, -i, j, -j, k, -k$, is simply a statement of the fact that the complex C_4 group has been dualistically extended, and, we can, again, represent the same information by a C_2 multiplication, using a group of the form $C_2 \times C_2 \times C_2$.

Continuing the process further, we dual Q_8 by complexifying it to the complex quaternion or multivariate 'vector' group $1, -1, i, -i, j, -j, k, -k, ii, -ii, ij, -ij, ik, -ik$, of order 16, which has a related $C_2 \times C_2 \times C_2 \times C_2$ formulation, and which may also be written $1, -1, i, -i, ii, -ii, ij, -ij, ik, -ik, i, -i, j, -j, k, -k$, where a complex quaternion, such as ii becomes the equivalent of the multivariate vector i (see Appendix I). (The alternative dualling of quaternions to octonions, with sixteen components, fails the test of group structure, as octonions are nonassociative.) We then expand the complex terms to a three-dimensional status, to produce a double quaternion group, say $1, -1, I, -I, J, -J, K, -K, i, -i, j, -j, k, -k$, of order 32, which has a related $C_2 \times C_2 \times C_2 \times C_2 \times C_2$ formulation. Then we complexify again, to produce a multivariate vector-quaternion group $1, -1, i, -i, ii, -ii, ij, -ij, ik, -ik, i, -i, j, -j, k, -k, i, -i, j, -j, k, -k, ii, -ii, ij, -ij, ik, -ik$, and 36 real and complex combinations of vectors and quaternions, forming a group of 64, with a related $C_2 \times C_2 \times C_2 \times C_2 \times C_2 \times C_2$ formulation. This is the algebra of the Dirac gamma matrices. Though further

dualling is possible on the same basis, it is clear that only three fundamental principles are required to continue the dualling to infinity – opposite signs (or equivalent), the distinction between real and imaginary components, and the introduction of cyclic dimensionality – and to establish every conceivable combination of these, that is to establish every type of dualling, requires a group of 64 elements. In addition the Dirac algebra includes a dualling of each of the dualling processes within itself, the eight groups of objects involved producing every possible combination of + / – × real / complex × nondimensional / dimensional:

C_2	C_2	± 1	
C_4	$C_2 \times C_2$	$\pm 1, \pm i$	complexify
Q_8	$C_2 \times C_2 \times C_2$	$\pm 1, \pm i, \pm j, \pm k$	dimensionalize
V_{16}	$C_2 \times C_2 \times C_2 \times C_2$	$\pm 1, \pm i, \pm i, \pm j, \pm k$	complexify
QQ_{32}	$C_2 \times C_2 \times C_2 \times C_2 \times C_2$	$\pm 1, \pm I, \pm J, \pm K, \pm i, \pm j, \pm k$	dimensionalize
VQ_{64}	$C_2 \times C_2 \times C_2 \times C_2 \times C_2 \times C_2$	$\pm 1, \pm i, \pm I, \pm J, \pm K, \pm i, \pm j, \pm k$	complexify

Though this appears to be a purely mathematical argument, in fact, it has a fundamental physical significance, in relation to the properties of the fundamental parameter group, for we can see now that two of the distinctions between the parameters, which we have derived inductively from observed physical characteristics (real / imaginary and noncountable / countable), are identical to the C_2 distinctions which extend the original C_2 duality into complexity and cyclic dimensionality. (Particularly significant, here, is the fact that countability or discreteness is a necessary requirement for cyclic multidimensionality, for unidimensionality is an obviously necessary property of a continuous or noncountable quantity – it can't have an origin. Multidimensionality is also a necessary property of discreteness, which has to have a reference or origin.) However, even the original C_2 duality (1 / -1) originated from the act of creating 'something from nothing' (1 from 0), the very definition of *nonconservation*, as is the concept of 'successor' which it implies. So, in principle, the group of space, time, mass and charge has all the elements required to extend physical duality to infinity.

And, when we express the parameters mass, time, space, and charge in terms of the respective scalar, pseudoscalar, vector and quaternion units (1, i , i , j , k , i , j , k), which their combined properties require, it becomes evident that the combination of the four parameters in the Dirac equation produces the complete self-dualling which we require. In addition, the Dirac nilpotent is the perfect way of producing something from nothing; its structure effectively incorporates or generates all the discrete and continuous groups of interest in fundamental physics, from C_2 to E_8 [Rowlands, Cullerne and Koberlien, 2001]; and the infinite imaging of the fermion state in the vacuum and the infinite entanglement of all nilpotent fermion states extend the dualling to infinity.

From the construction of dualities in terms of successive C_2 applications, it is possible to see why, in general, the constant terms produce effects which are $2 \times$ the changing terms, the real produce ones which are $2 \times$ the imaginary, and the discrete ones which are $2 \times$ the continuous: the multiplication occurs in the direction which doubles the options. The first combines + and – cases where it remains constant; the second involves squaring imaginary parameters to produce real ones; and the third combines dimensionality and noncommutivity with discreteness, and so doubles the elements. Examples of the first include action + reaction, absorption + emission, radiation + reaction, potential v. kinetic energy, relativistic v. rest mass, uniform v. uniformly accelerated motion, and rectangles v. triangles. Examples of the second include bosons v. fermions, and space-like v. time-like systems. Examples of the third include fermion + ‘environment’ (Aharonov-Bohm, Berry phase, Jahn-Teller, etc.), space-like v. time-like systems, particles v. waves, Heisenberg v. Schrödinger / the harmonic oscillator, quantum mechanics v stochastic electrodynamics / zero point energy; 4π v. 2π rotation, and all cases in which physical dimensionality or noncommutativity is involved.

The very concept of duality also implies that the actual processes of counting and generating numbers are created at the same time as the concepts of discreteness, nonconservation, and orderability are separated from those of continuity, conservation, and nonorderability. The mathematical processes of addition and squaring are, in effect, ‘created’ at the same time as the physical quantities to which they apply, while all the other fundamental mathematical concepts and processes (e.g. the Dedekind cut) are, in some way, defined by dualling. The factor 2 thus expresses dualities which are fundamental to the creation of both mathematics and physics, and duality provides a philosophy on which both can be based.

REFERENCES

Gough, W. [1990], ‘Mixing scalars and vectors – an elegant view of physics’. *Eur. J. Phys.*, 11, 326-33.

Rowlands, P., Cullerne, J. P., and Koberlein, B. D. [2001], ‘The group structure basis of a foundational approach to physics’, arXiv:physics/0110091.

Whitney, C. K. [2000], How can paradox happen?, *Proceedings of Conference on Physical Interpretations of Relativity Theory VII*, British Society for Philosophy of Science, London, September 2000, 338-51.

Alternative Natural Philosophy Association

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1. The primary purpose of the Association is to consider coherent models based on a minimal number of assumptions, so as to bring together major areas of thought and experience within a natural philosophy alternative to the prevailing scientific attitude. The Combinatorial Hierarchy, as such a model, will form an initial focus of our discussions.
2. This purpose will be pursued by research, publications and any other appropriate means including the foundation of subsidiary organisations and the support of individuals and groups with the same objective.
3. The Association will remain open to new ideas and modes of action, however suggested, which might serve the primary purpose.
4. The Association will seek ways to use its knowledge and facilities for the benefit of humanity and will try to prevent such knowledge and facilities being used to the detriment of humanity.

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