

Rehabilitating rationality in contemporary philosophy of science

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ABSTRACT

This article explores rehabilitating rationality in contemporary philosophy of science against the background of the objectivist/rationalist positions prevalent at the end of the 19th century. Subsequent changes of position are investigated by focusing on trends discernible in writings of 20th century philosophers of science. Here, a shift from rationalism to irrationalism and from objectivism to subjectivism occurred. The ensuing clash culminated into a yet unresolved impasse in contemporary philosophy of science. It is suggested that three mind-shifts may alleviate this unsatisfactory deadlock. Firstly, a better understanding of the need for a non-reductionist notion of rationality. Secondly, acknowledgment of the creational order as *locus ordinis* of rationality. Thirdly, an intensified awareness of modal and entitary abstraction.

OPSOMMING

Hierdie artikel verken die rehabilitasie van rasionaliteit in hedendaagse wetenskapfilosofie teen die agtergrond van die objektivistiese/rasionalistiese posisies heersend aan die einde van die 19de eeu. Daaropvolgende posisionele verskuiwings word ondersoek deur te fokus op onderskeibare tendense in geskryfte van 20ste eeuse wetenskapfilosowe. Daarin het 'n verskuiwing van rasionalisme na irrasionalisme en van objektivisme na subjektivisme plaasgevind. Die daaropvolgende botsing het in 'n tans nog onopgeloste dooiepoint in hedendaagse wetenskapfilosofie gekulmineer. Dit word aan die hand gedoen dat drie denkskuiwe hierdie onbevredigende dooiepoint mag ontlont. Eerstens, 'n beter begrip vir die noodsaak van 'n nie-reduksionistiese rasionaliteitsbegrip. Tweedens, erkenning van die skeppingsorde as *locus ordinis* van rasionaliteit. Derdens, 'n geïntensifiseerde bewustheid van modaliteitsabstraksie en entiteitsabstraksie.

Rehabilitating rationality in contemporary philosophy of science

“Rationality must be an aid to man’s understanding of the world around him; and an aid to man’s struggle for a meaningful and fulfilling existence. There is much more to our understanding of the cosmos and our quest for a meaningful life than the present (scientific) rationality allows for. The creation and implementation of an alternative mode of rationality will be but a stage in man’s cognitive and spiritual development” (Henryk Skolimowski, 1976:213).

1. Introduction

What can be observed in the development of 20th century philosophy of science is a clear shift from objectivism to subjectivism and from rationalism to irrationalism. Advantages of this developmental pattern are the liberation of rational scientific thought from the grips of positivism’s extreme objectivism (scientism) towards a more “humanitarian” emphasis (Feyerabend’s term). The disadvantages, unfortunately, are an over-emphasis on the subject (subjectivism) accompanied by increased relativism. On the philosophical level, subjectivism and irrationalism increasingly imposed themselves, thus requiring a more limited role for rationality in science.

I will begin this study by briefly addressing the two most prominent models of rationality prevalent from the beginning of Modernity until the end of the 18th century: foundationalism on the one hand and empiricism/positivism on the other. Both these models are inclined to rationalism and objectivism. Against that background I will capture the most important changes concerning rationality in the works of Popper, Lakatos, Polanyi, Kuhn and Feyerabend, being prominent 20th century philosophers of science. These changes can be summarized as a shift from objectivism to subjectivism and from rationalism to irrationalism. This shift brought about some advantages but also some disadvantages. The latter gave rise to an impasse, especially during the second part of the 20th century, leading to the postmodernist disenchantment with human rationality in general.

A brief analysis of the deep causes of these developments and problems will be proposed. It will also be suggested that rehabilitating the unresolved impasse requires avoiding the deadlock between objectivism and subjectivism and between rationalism and irrationalism by following a non-reductionist notion of rationality, seating its *locus ordinis* in the laws holding for both subjects and objects within the creation order. This strategy is suggested in order to avoid the misplacement of the law in entities (subjects or objects alike) and the ensuing conflict when such entities are supposed to become laws to themselves. In response to the dilemma concerning rationalism (focusing on universal knowledge) versus irrationalism (focusing on knowledge of the individual), both individuality and universality need to be understood (not as entities but) as traits of whatever exists in created reality. The two corresponding types of knowing (theoretical and pre-scientific), therefore, should not be contrasted or opposed but accepted as legitimate and necessary. In these ways, these deadlocks compromising rationality may be overcome.

It is good academic practice to be open about the “paradigm” adopted in one’s investigations. Too often, authors are inclined to concealing or disguising their deepest presuppositions. I therefore acknowledge that the analyses, ‘diagnoses’ and the remedies proposed in this study are in line with the philosophical trend known as Reformational philosophy.¹

2. The background: some relevant trends

Two predominant models of rationality (foundationalism, based on deductive reasoning and positivism/empiricism, based on inductive reasoning) prevailed from the beginning of Modernity until the end of the 18th century. Admittedly, they developed from views of human rationality that were there since antiquity. For the purpose of this article, however, I will focus on the modern period.

Foundationalism was based on the logic of deduction. “First principles”, *a priori* pre-experience, (innate) knowledge - those so self-evidently true that no rational mind could ever question their veracity – grounded this rationality. It foresaw absolute intellectual certainty

¹ Some readers may be less familiar with some authors mentioned in this study, who represent this trend (see e.g. Dooyeweerd, Clouser, Strauss, Hart, Botha, Coletto). For an introduction to this philosophical school see for example Clouser, 2005.

in pursuit of scientific knowledge. For Aristotle, (viewed as an “objectivist” *inter alia* because of his philosophy of Forms), the law of *non-contradiction* was such a first principle.² For Descartes, the act of thinking (i.e. “subjectivist”, inside man’s intellect) proved human existence (*cogito ergo sum*). *Rules* (so-called “objective” but subjectively postulated) for a rational mind’s reasoning characterised foundationalism. Aristotle mainly seated these rules in categorical syllogisms and the principles of identity, non-contradiction and excluded middle. Descartes advocated four rules for directing the mind: firstly, *absolute certainty* through clear and distinct reasoning; secondly, *division* (dissecting propositions into their smallest components to enhance understanding); thirdly, *order* (deducting in logical sequence further propositions from prior clear, distinct and self-evidently true ones) and, fourthly, *enumeration*, (numbering and reviewing each step in the course of the argument) (Copi & Cohen, 2002: 181, 217, 344-347; De Vleeschauwer, 1952:115; Gill, 2000:13-15; Kok, 1996:130,131; Schouls, 1981:42,43).

The *justification* of propositions requires their deductibility from self-evidently true first principles through deductive reasoning - rules of thought which *objectively* justify propositions because their origins are clear, distinct, certain, indubitable and independent of infinite regress. Foundationalism is a *justificationist rationality* standing on two legs. Firstly, to be accepted as proper premisses – “foundations” being immune from error, infallible and incorrigible – are those propositions which are *immediately*, (not *mediately*), without prior analysis, calculation, argument or subsequent inference self-evidentially true or clearly, distinctively and indubitably certain, known by themselves, not deriving their tenability from other propositions. Secondly, further (mediate) propositions are true (certain) once justified by their relation to the foundations. They can thus be relationally justified, deducted (inferred) from the foundations by logical rules in themselves clear and certain (Alston, 1976:165-167; 1992: 144-146; Briskman, 1990:169; Plantinga, 1983:40-44, 47, 48; Van Cleve, 1979:74).

² Metaphysics IV.4 (Aristotle, 1941:737): The most indisputable of all principles is that it is impossible for the same thing at the same time to be and not to be. People demanding *demonstration* of this are uneducated – they do not understand what requires demonstration and what not. Demanding demonstration of everything involves infinite regress, producing no demonstration.

Empiricism seats the criterion of cognitive meaning or significance in factual or experimental *testability* through the observation of phenomena. Its “observable characteristic” enables “observation predicates” and “observation sentences”. Only “empiricist language” achieves “empirical assertion” in the *explicandum* and a “rational reconstruction” thereof (Hempel, 1959:108-110, 116, 125). Supposedly, the results of observing physical matter (not logical argument) would provide the *explicans*. Only thereafter would logical (inductive) argument proceed (Briskman, 1990:169). However, *nihil in intellectu nisi prius in sensu*, the same “foundation” underlying positivism, remains the paramount principle. It should be noted, however, that empiricism does not exclude rationalism. In some texts dealing with the history of philosophy, empiricism is contrasted to rationalism as if the two were opposed and irreconcilable enemies. In many philosophers, however, empiricism is the first step leading to rationalism (or vice versa). Empiricism, therefore, does not exclude rationalism; it often accompanies it. This clarification should be kept in mind when considering the remarks of section 3 on the rationality-models that we have examined.

Positivism was an empiricist trend, based on *inductive* reasoning, producing *a posteriori* (post-experience) knowledge and proceeding from the arguments of its “father”, Auguste Comte. Three successive stages (the primitive theological one, the transient metaphysical one and the ultimate positive one) are discernible in the history of intellectual development. This law of “triple evolution” is testable by observation, experiment and comparison. In theological philosophy, man could not “dispense with supernatural aid” (Comte, 1961:1334) in achieving control over nature by knowing its laws. Reason replaced imagination, positivism being true universal reason. The metaphysical period was one of intermediate transition from the (primitive) theological to the positive, but this metaphysical transition was of “inferior intellectual consistency”, having “a bastard and mobile character”, embracing the speculative field after the theological has relinquished it, before the “rigorous unity” of the positive spirit appeared. “Material” development must follow a perfectly correspondent intellectual development (Comte, 1961:1332-1334, 1337-1339).

Comtian positivism dominated early 20th century philosophy of science and soon became a

sophisticated school of thought, called *logical positivism*.³ Its main tenet was: science needs to be “neutral”, liberated from all metaphysical considerations because metaphysics, values and norms are meaningless. All sciences, including the humanities, should be united and reduced to common fundamental *physical* terms. The rational method for science is observational and experimental *verification* through “factual” frequency trends. Sense-experience reigns. Science requires development through linking theory and fact in *protocol sentences* aided by “correspondence rules” (Ayer, 1935:4-7; Botha, 1988:39-41; Brown, 1988:49; Du Plessis, 2006:49-51; Hodge & Cantor, 1990:839, 844; Ray, 2000:243-248). Logical positivism acknowledged as rational only knowledge obtained and verified by experience, empirical, objective and factual observation – a *verificationist rationality*. Inductive generalisations, logical consistency, objectivity, verification and freedom from values are minimum requirements for rationality (Van Huyssteen, 1983:189-191).

In the above models of rationality some characteristics seem to prevail. We can firstly detect *rationalism*,⁴ which reached one of its high tides by the end of the 19th century; and secondly *objectivism*.⁵ It is not necessary to deny, during the same period, the existence of subjectivist and irrationalist inclinations: Kant (1724-1804) already postulated the theory that the human mind does not derive its laws from nature but imposes its laws upon nature, thereby elevating the mind of the knowing subject to the lawgiver for nature - an overly subjectivist stance. It is equally possible to detect irrationalist moments in Hegel’s philosophy. Mach’s version of positivism (with its almost exclusive reliance on “sensations”), is also quite subjectivist. During the 19th century, trends like vitalism, idealism or pragmatism can and

³ The “Vienna Circle” (*Wiener Kreis*), a group of philosophers at the University of Vienna founded by Moritz Schlick, over the period 1922 to 1936 propagated “logical positivism”. Ludwig Wittgenstein’s *Tractatus Logico-Philosophicus* (first published in *Annalen der Naturphilosophie* in 1921) had great influence on the Circle. In England, Alfred Ayer endorsed their thinking in his *Language, Truth and Logic* (1935), as did Herbert Feigl (a member of the “Minnesota Circle” in the USA) (Blackburn, 2008:214; Botha, 1988:60 fn 7; Newton-Smith, 1981:126; Urmson, 1960:290).

⁴ “Rationalism” denotes the over-estimation of universal (scientific) knowledge leaving no room for pre-scientific knowledge, focusing on what is individual. Its counterpart, “irrationalism” should not be confused with the illogical or non-rational. It denotes an over-estimation of human emotions, values, expectations etc. instead of “pure reason”. It also denotes an over-estimation of knowledge of the individual (Coletto, 2007a:1, 2 fn.1).

⁵ Objectivism seats the *locus ordinis* of reality and rationality in the objects of human experience. Its converse, subjectivism, seats that order in the mind of the knowing subject (Clouser, 2005:247; Coletto, 2007a:5 fn.3).

should be regarded as irrationalist movements. Yet it can still be argued that rationalism and objectivism were the prevalent trends up to the 18th century. To avoid misunderstandings, I would also emphasise that closely connecting “objectivism” with “rationalism” and “subjectivism” with “irrationalism” is not what I have in mind. Surely Kant was a “subjectivist” *per excellence* yet an ardent “rationalist” as well.

My introductory remarks about some rationalist/objectivist trends would clearly require more elaborate analysis in a more extended presentation. They will however help contrasting the new developments in philosophy of science and to better detect the profound changes that took place during the 20th century, when irrationalism and subjectivism claimed their rights and obtained the primacy in many philosophical fields. This was certainly the case in philosophy of science, as can be assessed with reference to five of 20th century’s most prominent exponents: Karl Raimund Popper (1902-1994), Imre Lakatos (1922-1974), Michael Polanyi (1891-1976), Thomas Samuel Kuhn (1922-1996), and Paul Karl Feyerabend (1924-1994). In the following sections, however, I will not only argue that subjectivism and irrationalism became prevalent. We will also observe the gradual shifts that led to their supremacy, and especially the consequences that took place. Such consequences were not always as desirable as the opponents of rationalism and objectivism might have expected.

3. From objectivism and rationalism to Popper’s rationality of methodological refutationism

Popper’s rationality closely follows his views on *scientific growth*. Science grows from tentative theories offered as problem solving attempts, coupled with error elimination.⁶ Science does not progress as positivists and empiricists mistakenly believed, through a bucket or container-like accumulation of sense experiences, but through critical questioning, like applying a searchlight to reality. This is so because we learn from our mistakes, through trial and error, replacing our existing theories by better ones through conjectures and refutations. A “better” theory is one surviving relentless attempted refutation, one purged of its

⁶ Popper (1972:144; 2002:548) sketched the process as $P1 \rightarrow TT \rightarrow EE \rightarrow P2$ where “P1” is the initial problem, “TT” the tentative problem-solving theory, “EE” the error eliminating process and “P2” the problem emerging from error exposure in the tentative theory.

predecessor's errors. Theories remain tentative and advance means "survival of the fittest" theories (Popper, 2002:171, 294-296, 548).

Falsification distinguishes science from non-science. Scientific theories can only be such if they are testable, falsifiable or refutable. Popper's scientific methodology of falsification underlies his conception of *critical rationality*. He was a "fallibilist": science is not a quest for certainty, probability or reliability - rather a hope to find improved theories by severely criticising and testing existing ones (Popper, 2002:310). Popper based his *critical rationality* in logic: deductive reasoning, following the hypothetical syllogistic form of *modus tollens*.⁷ His falsifying method of inference (*modus tollens* leads to the conclusion of $\sim q$, a negative) activates a rational methodology, attempting to falsify the conclusion, exposing the untenability of the system it is derived from (Popper, 1968:76): a hypothetical – deductive (inferential) method of reasoning. Should a theory contain a *contradiction*, it is *useless* for science. Dialecticism means contradiction – tolerance kills criticism, kills rationality and collapses science (Popper, 2002:426, 429-433). True rationality entails deductive, not inductive, reasoning.⁸ Logical reasoning proceeds through *rules of inference*. Should such logical rules be followed, the inference will be valid because the rule of inference to which it

⁷ *Modus tollens* and *modus ponens* are both valid argument forms. *Modus ponens* (the method of putting or affirming) takes the form of $p \supset q$; p ; $\therefore q$ (if p , then q ; p ; therefore q), a rule of inference enabling one to pass from p and $p \rightarrow q$ to q . *Modus tollens* (the method of taking away or denying) takes the form of $p \supset q$; $\sim q$; $\therefore \sim p$, (if p , then q ; not q ; therefore not p) a mode of inference enabling one to pass from not q and $p \rightarrow q$ to not p . (Blackburn, 2008:237; Copi & Cohen, 2002:327, 328). *Modus ponens* is accordingly assertative and affirmative in essence: if the *antecedens* is confirmed, the *consequens* is also confirmed (if p , then q ; p is true; therefore, q is true). Conversely, *modus tollens* is negative and traversitive: if the *consequens* is denied, the *antecedens* is also denied (if p , then q ; q is not true; therefore, p is also not true). Popper favoured *modus tollens* because of its traversitive nature, i.e. consistent with a falsificationist methodology in science.

⁸ Deductive reasoning ("deduction") infers particularities from generalities by showing that the conclusion follows logically from the premiss. Stated differently, the premisses of a deductive argument "are claimed to provide conclusive grounds for the truth of its conclusion" (Copi & Cohen, 2002: 181). Its converse, inductive reasoning ("induction") *infers generalities from particularities* by accepting empirical hypotheses "on the basis of evidence that gives them more or less strong, but not, as a rule, logically conclusive, support" (Hempel, 1965:73). In epistemology, the deduction/induction opposites lead to divergent consequences, and so also in the rationality of science. The fundamental "problem of induction" concerns David Hume's question whether there is anything "in any object, considered in itself, which can afford us a reason for drawing a conclusion beyond it". Hume's answer was that "we have no reason to draw any inference concerning any object beyond those of which we have had experience" (quoted in Howson, 2000:181).

appeals is valid. In turn, a rule of inference is valid if, and only if, it can never lead from true premisses to a false conclusion, i.e. the rule of inference is valid “if it unfailingly transmits the truth of the premisses (provided they are all true) to the conclusion” (Popper, 2002: 426, 427). Induction is logically unjustifiable because it entails infinite regress. Little can be said about the future based on past experience: the future extends beyond past experience; it will more likely be different from the past. Moreover, observation involves theoretical interpretation (Popper, 2002:55-59).

Positivist/empiricist rationality errs, according to Popper, in maintaining that theories can be *created* by observational results: they are created by first *asserting* conjectures, then *testing* them by experimental observation. The theory that “all swans are white”, based on millions of previous observations over centuries, was refuted only by a single observation of a black swan. This refutes empiricism as a theory: empiricism’s true function is limited to *testing* theories. “Protocol sentences” based on empirical observation of experimental results can only create *singular* statements, not the *universal* ones that science needs. Moreover, infinite regress is not overcome. It is of no use for logical positivists to argue that inductive inference, although not strictly valid, can attain some degree of probability or reliability – the inherent problem of induction is not even touched, let alone solved by an appeal to probability, because the fatal consequence of infinite regress remains (Popper, 1968:30; 2002: 72).

Popper’s rejection of positivist-empiricist inductive verificationist rationality, and preference for falsificationism in its stead, is based on an *asymmetry* between them; universal statements (hypotheses and theories) cannot be *derived* from singular or particular statements, but they can be *contradicted* by them. One can, through deductive inferences based on *modus tollens*, argue from the *truth* of singular to the *falsity* of universal statements. Falsification avoids the untenability of induction. Falsification entails “tautological transformations of deductive logic whose validity is not in dispute” (Popper, 1968:41, 42).

Despite his rather objectivist approach to rationality, Popper rejected the positivist ideal of value-free science. Wittgenstein's⁹ rationality was self-defeating by erroneously identifying natural science with *true* assertions (all-natural scientific statements are true and all other nonsense, i.e. untrue). He excluded from natural science all untrue hypotheses – but since we cannot know upfront whether or not a hypothesis is true, we cannot know whether or not it belongs to natural science. Hypotheses (“the most important of all scientific utterances” according to Popper, 1962:298) always go beyond a single clear statement of fact. Wittgenstein equated pre-scientific hypotheses with metaphysical nonsense and accordingly they were “thrown out of the temple of natural science” (Popper, 1962:298, 299). Wittgenstein's thesis - all metaphysics (being nonsense) are to be eradicated from science - is nonsense. If a metaphysical hypothesis, not initially known to be true, becomes known to be true by observation and experiment, it becomes *deeply significant nonsense*. Calling all metaphysical statements “nonsense” is a scientific nonsensical statement (Popper, 1962:297). The positivist anxiety to annihilate metaphysics, annihilates natural science (Popper, 1968:36).

⁹ Wittgenstein (1974:89) *Tractatus* (6.53, 6.54,7) wrote: “There are, indeed, things that cannot be put into words. They *make themselves manifest*. They are what is mystical. The correct method in philosophy would really be the following: to say nothing except what can be said, i.e. propositions of natural science – i.e. something that has nothing to do with philosophy – and then, whenever someone else wanted to say something metaphysical, to demonstrate to him that he had failed to give a meaning to certain signs in his propositions. Although it would not be satisfying to the other person – he would not have the feeling that we were teaching him philosophy – this method would be the only strictly correct one. My propositions serve as elucidations in the following way: anyone who understands me eventually recognises them as nonsensical, when he has used them – as steps – to climb up beyond them. (He must, so to speak, throw away the ladder after he has climbed up it). He must transcend these propositions, and then he will see the world aright. What we cannot speak about we must pass over in silence”. Ayer (1935:5, 11) followed by saying: “All metaphysical assertions are nonsensical”. No statement referring to a “reality” transcending the limits of sense-experience can have literal significance; “the labours of those who have striven to describe such a reality have all been devoted to the production of nonsense”.

Popper, later in his life, argued for a so-called “three worlds theory”. The “first world” is the physical one of physical states – that world which science attempts to explain. The second is the mental one of mental states – subjective human thought and experience. The third is the world of intelligibles – the world of objective human thought and its products (Ackermann, 1976: 55; Skolimowski, 1974: 493, 494). I will return to this topic later (see section 8), to discuss how this “three worlds theory” contributes to re-vitalizing the role of the subject in science.

In Popper’s philosophy we can therefore observe the first signs of a “revolt” against positivism, rationalism and objectivism. In his philosophy (which remains rationalist to a certain extent), the role of scientific rationality is moderated and the subject is re-admitted, as a legitimate citizen, within the country of science.

4. Lakatos’ rationality of scientific research programmes

Lakatos preferred *sophisticated methodological falsificationism* to dogmatic (“naïve”) falsificationism. A theory is not falsified before a better one emerges. Lakatos’ model blends empiricist rationality (learn from experience), the Kantian activist approach to knowledge and the foundationalist emphasis on methodology. “Knowledge” means “proven knowledge” - proven by either “the power of the intellect or by the evidence of the senses” (Lakatos, 1970:91). Scientists and philosophers sceptic of scientific knowledge being proven knowledge, undermine the “classical structure of intellectual values”. The ideal of *proven truth* cannot be subordinated to *probable truth* as some logical empiricists do, or to *truth by changing consensus*, as some sociologists of knowledge do (Lakatos, 1970:91-93; 119, 178).

Lakatos’ methodological rationality embraces a negative and positive heuristic: negative methodological rules inform avenues to avoid; the positives, which to pursue. These rules must be *objectivised* in *scientific research programmes*. Successful research programmes lead to “progressive” problem shifts; unsuccessful ones to “degenerating” ones. Rival research programme competition assists scientific progress (Lakatos, 1970:132-155). Lakatos’ research programmes introduced a new criterion for demarcating “mature” from “immature” science. The former embraces a methodological rationality while the latter consists of “mere patched up problems of trial and error” (Lakatos, 1970: 175). The “heuristic power” of this mature

science lies in anticipation of novel facts and auxiliary theories generating the *autonomy* of theoretical science: a requirement of continuous growth forming the rational reconstruction of the requirement of “unity” or “beauty” of science (Lakatos, 1970:175).

Lakatos’ rational reconstruction of Popper’s falsificationist rationality was this: any part of science is progressively replaceable if the replacing theory successfully anticipates novel facts. The direction of science “is determined primarily by human active imagination and not by the universe of facts which surrounds us. The well-planned building of pigeon holes must proceed much faster than the recording of facts which are to be housed in them” (Lakatos, 1970:187, 188).

In Lakatos’ philosophy we can therefore observe that he, like Popper, re-admitted the subject: the “facts” surrounding the subject are not paramount; what became more important (or at least equally important) is “human active imagination”. Yet Lakatos’ position remained to a considerable extent, like that of Popper, an objectivist-rationalist one.

5. A subjectivist turn: Polanyi’s enthymematic rationality

Polanyi urged the acknowledgment of the human factor in the rationality of science. An overly methodological rationality in science discredits ethics: no observations or measurements can determine the ultimate commitments of scientific action. We should appreciate Augustine’s *nisi crederitis non intelligetis* and recognise belief as a source of knowledge (Polanyi, 1946). Our understanding of nature, on which we rely for our mastery of the world, includes *tacit knowledge* (Polanyi, 1966) and *presuppositions* and also our sharing of an idiom, cultural heritage and our affiliation to a like-minded community. “No intelligence, however critical or original, can operate outside such a fiduciary framework” (Polanyi, 1962:266; Cattani, 1995:67; Coletto, 2008b:449). Imperfect knowledge can also be rational – we frequently believe and know something which we do not perfectly understand. Our knowledge extends beyond what we tell or can prove. What is not said is part of meaning (Polanyi, 1975). The presence of the implicit renders inference hazardous and rules out a notion of perfectly objective rationality (Cattani, 1995:70). Polanyi’s enthymematic

rationality¹⁰ implied that theories of rationality cannot be freed from personal tacit assumptions (Zyciński, 1995:258). Implicit, subsidiary (as opposed to focal) awareness forms part of human rationality in science because progress often involves expression of hidden tacit pre-scientific presuppositions (Polanyi, 1966). That background information is enthymematically involved in reasoning, argumentation, inference and observational-experimental science (Cattani, 1995:71). In this way, the role of the knowing subject becomes more prominent than in previous authors, rationality is re-defined and rationalism is basically abandoned.

6. A sociological turn: Kuhn's paradigmatic rationality

Kuhn's views on the role of rationality in science were inextricably interwoven into historical scientific development. He identified six phases characterizing scientific development. The first is a pre-paradigmatic phase characterised by random experiments, many schools, and lack of scientific consensus on the fundamentals of a discipline. The second is one of "normal" or "mature" science characterised by paradigm acceptance and consensus eliminating disputes on a discipline's fundamentals, facilitating focus on detail, specialisation, anomaly detection and *puzzle solving*, the criterion for demarcating science from non-science. In the third phase the scientist, detects anomalies unsolvable by the paradigm. The fourth phase entails crises necessitating paradigm shifts because of the existing paradigm's inability to overcome and solve persisting anomalies. The fifth, one of extraordinary or "revolutionary" science, is characterised by paradigm replacement. The new paradigm can solve puzzles which its incompatible predecessor could not. The next phase is one of resolution, resolving the prior paradigm failure, leading to enhanced puzzle solving ability. "Normal" science reappears and proceeds once again with puzzle solving within the new

¹⁰ In *enthymematic* syllogistic reasoning either the premiss or conclusion is not expressly stated. The unexpressed part of the argument is simply understood or in one's mind. In science, as in normal speech, inferences are often expressed enthymematically, because many propositions can be presumed to be common knowledge, not calling for repetition. Tacit premisses can be supplied by a listener to speech or reader of writings, mostly without much difficulty (Copi & Cohen, 2002:269; Cattani; 1995:70, 71).

paradigm (Kuhn, 1962:44-210; 1963:360-368; 1970a:2-21).

Kuhn regarded objectivity and open-mindedness as important elements of being scientific but cautioned that scientists fail to fulfil this ideal. Rather, scientists hold pre-research convictions: “the dogmatism of mature science”, i.e. a commitment to a particular *worldview* and how to practice science in that world. This has the effect that the “relatively dogmatic initiation into a pre-established problem-solving tradition” characterises scientific education. The student is neither invited nor equipped to evaluate such tradition (Kuhn, 1963:347-351). Paradigms are exclusive in that a specific group of scientists can adopt only one, and are determinative of the development pattern of the scientific discipline on which the paradigm adhering scientists focus. Shifts between paradigms echo the development pattern for mature science (Kuhn, 1963:352, 353, 358, 359).

Kuhn’s “paradigm” regulates his view on the role of rationality in science. This is so because the paradigm informs the entities with which the universe is populated and how they behave. The paradigm informs the questions to be asked about nature and the appropriate techniques for answering them. Moreover, scientists strive to bring their paradigm to closer agreement with nature. Because nature is too complex to be explored at random, the paradigm informs the scientists where to look and what to look for (Kuhn, 1963:359, 363) and, I maintain, *how to think*.

7. Subjectivism and irrationalism at a high: Feyerabend’s anarchistic rationality

Feyerabend argued that *rational anarchism* (being more humanitarian) is preferable to its (objectivist) alternatives. All restrictions, methodology included, need to be abolished for the individual to develop “freely, unhampered by laws, duties or obligations”. An “anarchistic methodology and a corresponding anarchistic science” is required (Feyerabend, 2010:1-5). Fixed methods of rationality reflect a naïve view of man and his social environment. The principle “anything goes” advances science and entails *counterinduction*, i.e. two “counter rules”. Firstly, develop hypotheses inconsistent with confirmed *theories*. Secondly, develop hypotheses inconsistent with established *facts*. A pluralistic methodology requires *ideas* rather than *experiences* to be compared, favouring hypotheses inconsistent with

observations, facts and experimental results (Feyerabend, 2010:13-16).

All methodologies have limits (Feyerabend, 2010:13-16). The *proliferation* of theories benefits scientific development, while *uniformity* impairs its critical power and man's development (Feyerabend, 2010:17-25). Science should be "the slave of our whims and not the tyrant of our wishes"; it is "our creature - not our sovereign" (Feyerabend, 1999:118). Rationality means applying the principle of *tenacity* (retaining a theory despite inconsistent data) while at the same time accepting a multiplicity of mutually inconsistent theories throughout the development of our knowledge (Feyerabend, 1970:203 fn 2; 2010:57). *Proliferation* welcomes increasing incompatible and incommensurable alternative ideas to be developed through criticism (entailing a comparison of and struggle between alternative views) to a higher degree of articulation, thereby raising their defence to a higher level of consciousness, i.e. a higher degree/level of individual human advancement. Also in science, the happiness and full development of the individual is the highest possible value (Feyerabend, 1970:210, 211). A humanitarian scientific enterprise is preferable to an "objective" one, impervious to human wishes (Feyerabend, 1970:228).

8. Evaluation: trends and movements

In the philosophies that we have just observed, a distinct turn from rationalism and objectivism to irrationalism and subjectivism is visible. The first indications are detectable by comparing the logical positivist position with that of Popper. Popper differed from the logical positivists' *structural* approach towards understanding science and preferred an approach focusing on scientific *growth*. *Facts and observations* are not the starting point of scientific inquiry as the logical positivists thought – *problems* are. And problems are formulated by the knowing subject. The basic conceptual units in science are not *protocol statements* but rather *tentative hypotheses*. Scientific theories are arrived at not by *induction* but rather by conjectures and refutations, bold guessing followed by relentless criticism (Skolimowski, 1974:487).

Popper's objectivism was neither seated in rationalism's foundationalist *justificationism* nor in positivist/empiricist *verificationism*. His objectivism was mitigated as he embraced intersubjective *testability*. Testable statements are not easily comparable with "ultimate"

statements like protocol sentences; they are refutable by falsification of the conclusions deduced from them (Skolimowski, 1974:486, 488, 489). This is, as we noted, the essence of the syllogistic rationality of *modus tollens*. *Intersubjective* testability replaces the *locus ordinis* from somewhere external to the knowing subject's mind to at least two knowing subjects' minds. Tentative hypotheses (conjectures) being the *knowing subject's* bold, unsubstantiated guesses, emanate from the mind. The initial conjectures can even be mythical: subjectivist and irrationalist, even though rationality is "rescued" in the *method* of error detection and elimination (Briskman, 1990:173).

Skolimowski (1974:493, 494) argues that Popper's "third world" theory links the objective with the subjective. This "third world" justifies the objectivity of scientific knowledge yet consists of the objects, the intelligibles of human thought. These *intelligibilia* are as objective as the *visibilia* (objects of sight). The third world is as *autonomous* as it is a product of human activity, i.e. both "super-human" and "man-made" - objectivity is linked with subjectivity in the "third world" (Skolimowski; 1976:198, 199). Ackermann (1976:55) argues that Popper's "third world" was an attempt to ground an objective notion of the growth of scientific knowledge. Watkins agrees, pointing out that, although man-made, the third world transcends its makers, "human minds are needed to create scientific theories and other intellectual structures, but, once created, the latter do not need 'knowing subjects' to sustain them: they stand on their own as objective structures in a quasi-Platonic 'World 3'" (Watkins, 2000:346, 347). Musgrave identifies Popper's *objectivism* in his analysing objective properties of scientific knowledge and formulating objective standards for criticising that knowledge. Hart (1984: 225) also interprets Popper's objectivity to be seated in standards of truth to which all our subjective knowledge must appeal. Objective standards of deducibility of the *explanandum* from the *explanans*, independent testability of the *explanans* and truth of the *explanans* are all *impersonal* (non-subjective) standards. This objectivism requires *methodology* as supplement (Musgrave, 1974:570, 575). Brown argues that although Popper's thesis falls within foundationalist rationality (e.g. his logicism, deductive reasoning, and denial of empiricism being a theory – creative device), the foundationalist need to seek *rules* governing rational decision remains unsatisfied. Popper's reasoning aided rebutting, refuting, falsifying and rejecting hypotheses without suggesting any algorithm for deciding

that a hypothesis has failed. The *modus tollens* alone cannot tell us which one or more of several initial hypotheses has been refuted and deserves rejection. Popper's thesis cannot "guide a rational decision": he proposed a *methodology* (guidelines for the manner of conduct of science and the search for knowledge), but resorted to *convention* based on common purpose as a reason why such, and not some other guidelines, should be accepted. "The choice of that purpose must, of course, be ultimately a matter of decision going beyond rational argument" (Popper, 1968:37). Popper's entire structure of rational analysis accordingly, argues Brown (1988:62-70), rests on a non-rationalist foundation. Popper was not a subjectivist, yet the more active role he attributed to the knowing subject signalled a move towards subjectivism (Coletto, 2007b:586).

Polanyi's theses too evidence a decisive shift from objectivism to subjectivism. From his point of view, Popper's falsificationist rationality promotes a dispassionate science, leading to indifference towards pre-scientific suppositions and discredits ethics because "no conceivable occurrence, no measurement or observation, can decide whether any action is moral or immoral, just or unjust, good or evil... As long as science remains the ideal of knowledge, and detachment the ideal of science, ethics cannot be secured from complete destruction from sceptical doubt" (Cattani, 1995:66; cf. Polanyi, 1975:27, 225). In acknowledging the importance of culture, tradition, shared values and ethics in science, Polanyi's difference with positivistic rationalism and objectivism is manifest. Polanyi's anchoring of scientific certainty in the knowing subject (Coletto, 2007a:37, 38) and consequent inclination to subjectivism does however not imply the de-objectivation of science (Coletto, 2008a:24), because "man can transcend his own subjectivity by striving passionately to fulfil his personal obligations to universal standards" which are both rational and trans-subjective (Zyciński, 1995:255; cf. Polanyi, 1962:17). Polanyi did not endorse relativistic subjectivism but located "a viable pivot point" between the extremes of objectivity and subjectivity, argues Gill (2000:28, 29). Tacit knowing, consisting of functional, phenomenal, semantic and ontological awareness, has important implications for science, argues Coletto (2011:69). The impact of the personal factor does have a subjectivistic consequence, but it also serves as a "bridge" between subjectivism and objectivism, problem and discovery, individual clues and the formation of universal concepts (Coletto, 2014:3).

With Popper and Polanyi, therefore, we can see that moving away from rationalism and objectivism does not mean their complete abandonment. Rather, we observe a search for balance, integration and concordance. The shift towards irrationalism and subjectivism, however, intensifies in the next authors.

Kuhn was critical of Popper's logicist falsificationist rationality and argued that falsification is nothing else than conclusive disproof. Popper's falsificationist rationality presupposes that theories are cast in a form permitting classification of all events as either confirmative, refutative or irrelevant to the theory (Kuhn, 1970a:15). Moreover, according to Kuhn, logic is an essential but not the only tool of scientific enquiry because sound knowledge, in forms other than strictly logical ones, does exist, i.e. sound knowledge to which logic can scarcely be applied. Logical articulation is not a "value for its own sake". It may be undertaken "only when and to the extent that circumstances demand it" (Kuhn, 1970a:16). Nature cannot be forced into arbitrarily selected "conceptual boxes" just as little as nature can be indefinitely confined in any scientifically constructed sets. Existing theories of rationality need readjustment or change explaining "why science works as it does" (Kuhn, 1970b:263, 264).

As suggested above, Kuhn seems to imply that the paradigm regulates scientists' individual or collective thought. Andersen (2001:66, 67) suggests that Kuhn's emphasis on the scientific community (not individual scientists) as the principal agent of science, facilitates interpreting his thesis. Paradigm shifts entail the revolutionary transformations required for scientific development. The values shared by the particular scientific community provide science's rational basis. The paradigm serves as a "common body of belief" providing the criterion for distinguishing relevant from irrelevant facts (Andersen, 2001:32). The *paradigm shift* entails a *rationality shift* because in the revolutionary development stage *the way in which scientists think* changes profoundly: not only inter-communal *persuasion* occurs, but also rational *conversion* which Kuhn (1962:204) called "neural reprogramming". Andersen seems to suggest that Kuhn implied that the paradigm (a collective pattern of rational thought) determines the individual scientist's thought. This "neural reprogramming" does not necessarily presuppose a critical role for logic (as Popper thought). The new paradigm, like its predecessor, results in the scientist being equipped with theory, methodology and standards together in an inextricable mixture (Shimony, 1976:578, 579). Lakatos (1970:178,179) argued

that the new paradigm “brings a totally new rationality” not seated in the individual scientist’s mind but in the collective wisdom of the particular paradigm adopted by the scientific community. In the final analysis, these interpretational differences do not eliminate the fact that: Kuhn’s thesis offered a truly subjectivist position (Coletto, 2007a:44, 45).

Lakatos’ differences with Popper also evidence a shift towards subjectivism. His “sophisticated falsificationism” and rationality of research programmes simply suggests that negative and destructive criticism (“falsification” or “refutation” or inconsistency detection) *does not eliminate* a scientific research programme. Constructive criticism is required. Nickles (1990:159) argues that Popper’s methodology is a “critical-eliminative” rather than a “constructive” theory of enquiry. For Lakatos, competing rival research programmes assist rationality in science, which Skolimowski (1976:200) argues to be an endorsement of Feyerabend’s proliferation theory. Yet, by emphasising the common purpose of research programme participants, Lakatos somehow endorses a “paradigmatic” rationality akin to that of Kuhn. Nickles (1990:159) describes Lakatos’ methodology as an attempted reconciliation of Popper’s and Kuhn’s theories of science, in that both components of Lakatos’ research programme, (its “hard core” of unrevisable principles and the “protective belt” of revisable claims) provide heuristic guidance to theory creation. Admittedly, Lakatos (1970:91-93; 178) denied this and referred to Kuhn’s rationality as “a matter of mob psychology”.

Feyerabend’s hedonistic views of science and its rationality represent the completed circle from objectivism to subjectivism and from rationalism to irrationalism. His hedonism and his “involutionary” view of scientific progress are diametrically opposed to the “myth of objective knowledge” (Coletto, 2009a:164). Yet from his extreme subjectivist position valuable insights can be gained. *Rationality* does feature in Feyerabend’s thought, as does *methodology*. “Anything goes” does not rule them out. Lugg interprets Feyerabend to say that there is *no special scientific rationality* superadded to ordinary rationality. Ordinary rationality suffices for science; “anything goes” merely uncovers methodological fallibilism. What needs to be appreciated in Feyerabend is his defiance of *scientism*, an uncritical idolisation of science. There is no such thing as a *distinctive scientific rationality* elevated above other human endeavours (Lugg, 1977:762-764; 769, 771, 774). Skolimowski (1976:203) expresses similar sentiments in arguing that Feyerabend presented a theory of methodological anti-absolutism:

science contains no “sacred canons” and is neither sacred nor absolute. The fact remains, however, that even if we take into account Lugg’s and Skolimowski’s remarks, Feyerabend’s position is a subjectivist and an anti-rationalist one. He actually reaches a higher degree of both in comparison with other 20th century philosophers of science.

9. Evaluation: trends, problems and root-causes

9.1 *Foundationalism, empiricism, positivism*

Having identified these trends in 20th century philosophy of science, where does this leave us? In an ongoing clash between rival methodologies and interpretations? Skolimowski (1976:196, 197, 205) argues that 20th century philosophy of science left us with an erosion of the notion of the rationality of science. Different paradigms entail different presuppositions concerning the rationality of science. Are we in a period of conceptual chaos, anarchy and unreason? I submit that we need an altogether new beginning in our reflection on the role of rationality in science. Our heritage from the 20th century is unsatisfactory. It resulted in an impasse between objectivism and subjectivism and between rationalism and irrationalism.

Foundationalism and positivism failed to produce absolutely certain, indubitable (Cartesian or Vienna Circle perceived) knowledge. Positivism’s neutrality–postulate became a viewpoint without a standpoint (Du Plessis, 2006:51). Empiricism did not produce a balance between the physical and non-physical realities of human life. Ayer and his followers never even appreciated that to be a fundamental problem, requiring a solution. Rationalism and objectivism failed to cater for human needs, desires, emotions and desperate search for *meaning* in life. Irrationalism and subjectivism failed to prevent an ever increasing quackmire of relativism which, in its extreme forms, undermines the very notion of rationality as ordered reasoning with constructive instead of destructive results. What Coletto (2007a) a decade ago identified as a legitimacy crisis for science, became a legitimacy crisis for mankind’s rationality. Moreover, probabilism failed to come to the rescue because even “high probability bears no connection to truth” (Briskman, 1990:172). As Hart (1981:179) observed, commitment to rationality demands that all that is rational must itself also be rationally justified. An endless regress is then required, which will never succeed in justifying rationality. Reason will first destroy the world in which it exists, then it will create a world of

its own which it will also not be able to support for lack of reality, and finally it will have made itself unacceptable to the world and to itself.

9.2 *Objectivism and subjectivism*

Both objectivity and subjectivity, if connected properly, have their legitimacy and imply advantages. Objective features (logic, mathematical calculation, unprejudiced, intersubjective experimental testing etc.) are legitimately scientific. The advantages of subjectivity are also obvious. Science is not divorced from human elements such as worldviews and beliefs. Human potential, values, views and so forth are to be part of the scientific enterprise. Science remains, at the end of the day, a *human* activity (Van Niekerk, 1992:121). However, as with all “-isms”, objectivism or subjectivism create tensions. Objectivism dehumanises science while we desire no Frankensteinian dehumanised world inhabited by robot-like humans or human-like robots. Objectivism tries to eliminate or to minimize the role of the knowing subject (presuppositions, human needs, interpretation and so forth) from science and scholarship. Subjectivism becomes self-defeating relativism¹¹ – it creates a world wherein

¹¹ Relativism essentially holds that a community or the individual is the sole judge of knowledge and truth. Truth is *relative* because it is always *related* to a certain time, culture and community. In its most radical forms, no standard other than each individual’s own determinations exist. Any belief or proposition is as good as another and is both true and false. Relativism is contained in Kuhn’s idea of incommensurability – the inability to incorporate someone else’s conceptions coherently into the terms of reference of one’s own. The Rortian compromising or even relinquishing of the principal basis of truth and rationality and, as a consequence, epistemology itself, offers a further example of relativism. Relativism contains serious incoherences. If everything is forever relative, that statement is in itself also relative. If anybody or everyone can claim something (because knowledge is relative) it is senseless to test the veracity of allegations. The claim that all propositions are true (because knowledge is relative) is self-undermining because, if that claim is true, other propositions must be false. The inevitable consequence of the relativistic thesis is that no objective standards remain for truth and rationality, which in effect means the relinquishing of rationality (Van Niekerk, 1992:20, 21, 121-123, 125-128, 165-168, 228). Tarnas (1991:27,28) also highlights the dangers of relativism: it leads to chaotic conflicts; no basis remains to certify one theory above the next; each person has his/her own reality; there is no objective reality; all understanding is subjective opinion and entails only probabilities, no absolute truths are knowable. This all goes to the root of the spirit of postmodernistic disenchantment: radical uncertainty; indecision; value-freedom with attendant immorality and lack of ethics; normlessness with attendant mediocrity instead of striving towards excellence; cynicism; scepticism; irresolution; lack of authenticity; meaninglessness in life; untruthfulness, etc. On its own terms, relativism contains the irony that in rejecting absolutism, it asserts an absolute position i.e. that it is an eternal truth that there is no eternal truth. “Everything could change tomorrow. Implicitly, the one postmodern absolute is critical consciousness which, by deconstructing all, seems compelled by its own logic to do so to itself as well. This is the unstable paradox that permeates the postmodern mind” (Tarnas, 1991:402).

“anything goes”, man becoming the sole arbitrator of knowledge and truth, and incoherence and incommensurability abound – because the “regulatory idea” of *truth* is relinquished (Van Niekerk, 1992:20, 21, 141, 228). Even inter-scientist communication and dialogue comes under threat (Coletto, 2008b:464-465; Du Plessis, 2006:59). Both objectivism and subjectivism should therefore be avoided. Some clarifications are however needed about the connection between subjectivism and relativism.

Kant’s “Copernican revolution” (the human mind does not derive its laws from nature but imposes its laws upon nature) was an important step in a process in which the human subject started replacing the object of study as the primary *locus* (foundation) of human knowledge and rationality. Kant managed to escape the possible relativist implications of subjectivism by making the categories (in the mind of the subject) universal and equal for all. However, the *subject* can be (and later on indeed was) regarded as constituted by a more specific/limited community or even by an individual. The more the subject is linked to individuality, the more relativism creeps in. “Intersubjectivity” (consent amongst groups or individuals) is no solution. “Intersubjectivity” does not become “objectivity” because more than one (perhaps only two) “subjects”, often sharing the same paradigm (perhaps incommensurable to others), concur. Let us now consider the second conflict that we have identified.

9.3 *Rationalism and irrationalism*

During the 19th century the conflict between rationalism and irrationalism became intense. While dialecticism and romanticism introduced a sort of irrationalism, Comte’s positivism and Ayer’s empiricism in the early 20th century maintained a rationalist position. During the 20th century, awareness of the deadlock or “impasse” inherent in the interplay of rationalism and irrationalism (Hart, 1981) gradually emerged. During the 20th century, however, irrationalism gained more ground. I have already mentioned (see section 9.1) some problems linked to rationalism; now I would like to briefly mention the problems of irrationalism, as it is a dominant trend of our times. Since approximately the mid – 1900’s, irrationalism (Van Niekerk, 1992) led to the postmodern disenchantment (Tarnas, 1991:400). In philosophy of science, the advantages of the developmental pattern inspired by irrationalism (that I have displayed above) were the liberation from positivism and its extreme objectivism (scientism),

towards a more humanitarian emphasis, but unfortunately the disadvantages became very soon apparent. Confidence in rationality, scientific progress, even the possibility of scientific communication was to a large extent undermined. The possibility of distinguishing scientific from non-scientific thinking (i.e. of tracing a “demarcation criterion”) seemed increasingly utopian. At the same time, the importance of presuppositions (paradigms, theories, Polanyi’s “commitment”, but even Feyerabend’s “preferences” or “whims”) increasingly appeared as the main concern of science.

In order to try and provide suitable alternatives to the problems discussed above, it is necessary to penetrate more deeply to their roots.

9.4 *Exploring the roots*

In my analysis, the tensions between objectivism and subjectivism, and between rationalism and irrationalism, have their root cause in the mutual exclusivity of the two opposite poles of what Dooyeweerd calls the “humanist ground motive”. The inner tension between the poles of nature and freedom of the humanist ground motive was explained by Dooyeweerd (1979:152-154) to be the following.

The nature pole generates the ideal of *control* of nature (via natural science) while the freedom pole generates the ideal of the autonomous personality, independent of any form of control in order for man to take his fate into his own hands. But the control motive requires nature to be subjected to man by means of mathematical or natural science. The natural-scientific method knows no limitations. The universal laws of mechanical motion (a closed chain of cause and effect) control the scientific ideal. “Autonomous man trusts and depends upon the certainty of his thought” (Dooyeweerd, 1979:153), but what then remains of *human freedom* when science controls a world characterized by determinism? If man belongs to created nature (and is subjected to its laws) he cannot possibly be free and autonomous. In this way nature and freedom, science and the human free personality, come into conflict – they become mutually exclusive. Man’s autonomous and free will (in the freedom pole) cannot be subjected to nature’s rules: a clash of control or supremacy. The classical natural-scientific ideal inspired early humanism in its early scientific endeavours; it was later substituted by the freedom ideal, leading to the adoption of historicistic methods in science.

Since then, humanist rationality remained vested in man's faith in his own autonomy – a faith which “could not tolerate the acceptance of a creation order to which man, quite independently of his own subjective thinking and volition, is subject” (Dooyeweerd, 1979:217). This remains today's main trend in the academic world, even though it does not exclude occasional returns to the ideal of technico-scientific control, inspired by the nature-pole.

9.5 *Linking the problems to the roots*

How are the dilemmas that we have explored (subjectivism/objectivism and rationalism/irrationalism) related to the ground motive of nature and freedom? From a humanist point of view, objects are linked to the nature pole, while subjects are linked to the freedom pole of this ground motive. This is the ultimate background setting the scene for the conflict between objectivism and subjectivism in our time. Of course, objectivism and subjectivism pre-date the appearance of the ground motive of nature and freedom. In our time and culture, however, the conflict receives its particular meaning, function and intensity from the dialectical conflict between an objectivised nature and an autonomous human personality. As we have noted, objectivism cannot be connected only to rationalism; and subjectivism cannot be linked only to irrationalism. There are both rationalist and irrationalist versions of both objectivism and subjectivism.

The conflict between rationalism and irrationalism, however, can also be connected to the humanist ground motive. According to Dooyeweerd (1953, 1:101-103; 1953, 2:8, 31, 36, 41; 1979:155, 184, 212), one of the consequences of this ground motive (and others) is the “absolutization” of certain aspects of reality (i.e. reductionism). I will now try to explain the link between absolutization and the rationalism/irrationalism dilemma.

Obviously, every scientific discipline abstracts *an aspect* of reality that is selected to become its investigational focus. However, the error of reductionist thinking is to reduce the remaining aspects of reality to the selected one, thereby either denying their reality, or explaining them as generated by the selected one, which has independent existence and on which all else depends. This denies the truth that all aspects of created reality are equally real, simultaneously true and holding for all creatures, inter-connected and mutually

irreducible (Clouser, 1996:82, 83). We cannot abstract (isolate and then absolutise or idolise) any single aspect of reality from the others without distorting their meaning and our reasoning.

Concerning the rationalism/irrationalism tension, both are prone to the error of reductionism. Rationalism absolutises reason at the cost of other realities of human life, leading to mistakes like “autonomous ratio” as if all human existence or knowing could be reducible to rational existence or knowing. In balanced human reasoning we also find active, living bodily knowing, sensitive and purposive knowing, socially conscious knowing, ethical and just knowing, loyal and faithful knowing, etc. – all characteristics of knowing that are *constitutive* of knowing and evenly characteristic of it as its rationality (Hart, 1981:184-190). Irrationalism, on the other hand, absolutizes non-rational “faculties” or tendencies, such as e.g. dialecticism’s contradictions and relativism’s self-undermining. In fact, irrationalism is not simply about recognizing other dimensions of human knowing that integrate rationality. In most of the cases, emotions, perceptions, social constructions or language are absolutized and taken to substitute (not to integrate) rationality in new forms of reductionism (cf. Feyerabend).

If we define rationalism and irrationalism (see fn. 3) as trends that over-emphasize either knowledge of the universal or of the individual, we can regard them as reductionist trends from another point of view. In terms of Dooyeweerd’s theory of modal aspects, individuality is “seated” especially in the numeric aspect of experience and universality is seated in the spatial aspect (cf. Strauss, 2009:60; 239; 449-464). These two trends constitute then, from this point of view, absolutizations of these two particular aspects of experience.

After observing the root-causes of the conflicts identified in this study, it is now time to provide some possible alternatives, in view of a rehabilitation of rationality.

10. Overcoming the impasse: some suggested alternatives

10.1 Three mindshifts

Three mindshifts may alleviate the tension between objectivism and subjectivism and between rationalism and irrationalism. Firstly: avoiding reductionism. Secondly:

acknowledging the law-side of the creation order. Thirdly: applying modal in addition to entitary abstraction.

10.2 Non-reductionist rationality

Concerning the tension between objectivism and subjectivism, we have seen that both are prone to the error of reductionism. In short: to be avoided is the mistaken view that, by intellectually abstracting one aspect of reality for scientific inquiry, that selected aspect becomes *independently* real, i.e. not remaining part of the inter-aspectual connectedness from which it was intellectually removed (Clouser, 2005:196). This requires a non-reductionist ontology. Ontologies like the ones elaborated by Dooyeweerd (1953, 2:3-180), Clouser (2005: 185-233) and Strauss (2009:67-103; 143-253) explicitly aim at avoiding reductionism. In their ontological views, a variety of modal aspects are placed alongside each other without regarding a specific aspect or set of aspects as more real than the others or as generating the others.

The clashes over method (methodology), so characteristic of 20th century philosophy of science, are also instances of reductionist thinking. We can escape the methodological deadlock by accepting that more than only one method can be valid and that, despite Popper's objections, both deductive and inductive reasoning can be applied in science. We should avoid reductionist thinking, also when thinking about methodology, and accept that no single method is sufficient to solve all problems (Du Plessis, 2006:56; Stafleu, 1987:152, 153).

10.3 Laws for the creation order

Recognising the laws that hold for the creation order avoids the distortions created by objectivism and subjectivism— distortions following from placing the source of order in either the subject or the object. Objectivism and subjectivism can be defined as strategies that misunderstand the nature and role of the law as originating from either subjects or objects, i.e. from entities. Although laws are correlated to entites, laws ought to be properly distinguished from entities and given their rightful place in both ontology and epistemology. Entities are not laws. Therefore, a conflict is created when entities are supposed to become

laws to themselves. The creation order and its laws are the source of order for both subjects and objects (Clouser, 2005:248, 279). In this way both the subjects and objects become subjected to the creation order. To illuminate our rationality (inclusive of our scientific rationality) we should avoid misplacing the laws for the creation order in *entities* (subjects or objects). We should rather recognise them as laws which hold for them.

Recognition of the created order is also a good antidote to relativism (which is linked to subjectivism). In Coletto's (2016:16) words: "Relativism is not the automatic result of the recognition of the role of the knowing subject in the process of scientific theorizing. Rather, relativism is indirectly proportional to the lack of recognition of a structural order for reality, which holds for both subjects and objects. In other words, although subjective points of view are real and inevitable, they all deal with a given order which is not constructed by the subject. This is the point of anchorage which is needed to escape relativism. Once the reality of the "creational order" (Dooyeweerd, 1979:68, 89, 146, etc.) is acknowledged, the recognition of a vast variety and diversity of points of view is not problematic and it does not plunge us into the deep sea of relativism".

This leads to the third mindshift I have in mind, i.e. the need for modal in addition to entitary abstraction.

10.4 Modal and entitary abstraction

The conflict between rationalism and irrationalism can be overcome by understanding both individuality and universality as traits of whatever exists (Hart, 1984:368, 369). These traits are the focus of two equally important ways of knowing, being pre-scientific and theoretical knowing, focussing respectively on the individual and on the universal. We have seen that these two ways of knowing are "absolutized" respectively by irrationalism and rationalism. As these two ways of knowing build upon and integrate each other, there is no point in absolutising one of them or in de-valuing the other.

11. Conclusion

This article proposed a rehabilitation of rationality in contemporary philosophy of science. After describing some rationalist and objectivist trends of the past, it described two main

shifts during the 20th century: a shift from objectivism to subjectivism and a shift from rationalism to irrationalism. While objectivism and rationalism implied advantages and disadvantages, as also subjectivism and irrationalism, they could not be reconciled. On the contrary, they clashed, causing an impasse towards the end of the 20th century. That impasse compromised the role of rationality in science. It has been argued that the impasse can be alleviated by, firstly, a non-reductionist view of rationality in science. Secondly, by accepting the creation order as a lawgiving reality in which rationality is seated. Thirdly, by accepting both modal and entitary abstraction as legitimate forms of abstraction leading to equally legitimate forms of knowing that integrate and build upon each other.

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