Changes in epistemic frameworks: Random or constrained?

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Since the emergence of a solid anti-positivist approach in the philosophy of science, an important question has been to understand how and why epistemic frameworks change in time, are modified or even substituted. In contemporary philosophy of science three main approaches to framework-change were detected in the humanist tradition:

1. In both the pre-theoretical and theoretical domains changes occur according to a rather constrained, predictable or even pre-determined pattern (e.g. Holton).
2. Changes occur in a way that is more random or unpredictable and free from constraints (e.g. Kuhn, Feyerabend, Rorty, Lyotard).
3. Between these approaches, a middle position can be found, attempting some kind of synthesis (e.g. Popper, Lakatos).

Because this situation calls for clarification and systematisation, this article in fact tried to achieve more clarity on how changes in pre-scientific frameworks occur, as well as provided transcendental criticism of the above positions. This article suggested that the above-mentioned positions are not fully satisfactory, as change and constancy are not sufficiently integrated. An alternative model was suggested in which changes in epistemic frameworks occur according to a pattern, neither completely random nor rigidly constrained, which results in change being dynamic but not arbitrary. This alternative model is integral, rather than dialectical and therefore does not correspond to position three.

Verandering in epistemiese raamwerke: Willekeurig of beperk? Sedert die eerste verskyning van ŉ soliede anti-positivistiese benadering in wetenskapsfilosofie, is ŉ belangrike vraag hoe en waarom epistemiese raamwerke oor tyd verander, gewysig of selfs gesubstitueer word. In kontemporêre wetenskapsfilosofie kan drie hoof benaderings tot raamwerk-verandering in die humanistiese tradisie bespeur word:

1. In beide pre-teoretiese en teoretiese domeine vind verandering plaas volgens ŉ taamlike beperkte, voorspelbare of selfs voorafbepaalde patroon (bv. Holton).
2. Verandering vind plaas op ŉ wyse wat meer willekeurig of onvoorspelbaar en sonder beperkings is (bv. Kuhn, Feyerabend, Rorty, Lyotard).
3. Tussen hierdie benaderings kan 'n middel posisie aangetref word, wat ŉ tipe sintese probeer handhaaf (bv. Popper, Lakatos).

Hierdie situasie noodsaak verduideliking en sistematisering en die artikel het dan gepoog om meer duidelikheid te bied oor hoe verandering in pre-wetenskaplike raamwerke plaasvind. Verder is transendentale kritiek van die bogenoemde benaderings in die artikel aangebied. Die artikel het voorgestel dat die bogenoemde benaderings nie volledig bevredigend is nie, aangesien verandering en konstantheid nie tot ŉ voldoende mate geïntegreer is nie. ŉ Alternatiewe model is voorgestel waarin verandering in epistemiese raamwerke plaasvind volgens ŉ patroon wat nie heeltemal willekeurig of beperk is nie, sodat verandering dinamies is, maar nie arbitrêr nie. Laasgenoemde posisie is integraal, eerder as dialekties en stem dus nie met posisie drie ooreen nie.

Orientation

In a previous study (Loubser in press [a]) I have explored the characteristics and functions of epistemic frameworks that are recognised, to a fair extent, by contemporary philosophers of science in both the humanist and reformational tradition. The conclusion of the investigation was that several pre-scientific frameworks are widely recognised as influencing scientific inquiry. Concomitant with the recognition of the role of pre-suppositions in science, it has also become evident that epistemic frameworks seem to have some kind of plasticity or capacity for change and this raises a basic question: how does change in epistemic frameworks take place? This is the problem statement of my current article, which forms (together with the previous study mentioned above) part of a research project, consisting of four articles in total, on patterns of change in epistemic frameworks.

Unlike the previous article, here both pre-scientific and scientific frameworks are considered (the latter being discussed most). In contemporary philosophy of science the demarcation between pre-scientific and scientific thinking has been complex and problematic (cf. Coletto 2011) and falls outside of the scope of this article. However, I should at least clarify that in this article terms like 'pre-scientific' (or 'pre-theoretical') refer to frameworks such as religious ground motives and worldviews, whilst terms like 'scientific' (or 'theoretical') refer for example to philosophy, a theorem, a special science and other related frameworks. In some cases frameworks contain both scientific and pre-scientific elements, for example Kuhn's idea of the paradigm and subsequently also the disciplinary matrix (cf. Loubser in press [a]).

The term 'change' refers to variations in the presuppositions, content and convictions embedded in epistemic frameworks. These variations can be either intrinsic (causing more profound change) or peripheral (causing only superficial change). I do *not* imply, however, that an epistemic framework (e.g. a worldview) can be transformed into a different type of framework (for instance a religious ground motive). The issue of change should be regarded as related but not identical to the theme of progress. In fact, the main question of this article is not whether or not, or how scientific progress occurs but how change (progressive or not) occurs.

In some cases, in contemporary philosophy of science it has been argued that changes in epistemic frameworks occur according to a constrained pattern (in both the theoretical and pre-theoretical domains). For example, in the case of the theoretical domain, Holton (1973:13–18) has argued that changes are not random, but follow at least some predictable lines.

In other cases, however, arguments are provided in support of the opposite view, namely that changes in epistemic frameworks are to a large extent random or free and unpredictable. Kuhn (1970a:176; cf. 1970b:260–263), for example, might be interpreted as viewing changes in paradigms as a result of persuasion due to propaganda (Lakatos 1970:177–180; 140 fn. 3), whilst Feyerabend (1975:40; 43–46 & 1985:xiii) proclaims that 'anything goes' in terms of method and that changes occur randomly also at worldview level. Contributions from Rorty (1990:3–15) and Lyotard (1984:83–86) also seem to support the idea that changes are quite unpredictable. Between the above mentioned opposite views, a middle position, attempting a kind of synthesis, is found. Arguments by Popper (1963:132; 222 & 1970:57) and Lakatos (1970:91–195) seem to be in support of such a middle position. These rather polarised approaches call for clarification and systematisation: do changes in epistemic frameworks occur in a random or patterned manner?

The hypothesis underlying this article is that change and constancy are related to epistemic frameworks according to a pattern referring to the irreducibility of coherents[1], where change and constancy exist in cohesion. Constancy is the necessary substrate for change in such a way that change cannot occur or be detected without reference to constancy. In this hypothesis, I agree with Strauss (2009:13 cf. 163–167) that change can only occur 'on the basis of something persistent or constant'. This means that change does occur but is never completely random or absolute. Instead, it is deeply integrated with constancy. Although at this stage this hypothesis can only be introduced, a full discussion and justification are provided in a further article (Loubser in press [b]).

The issue of change and constancy is one of perennial interest in philosophy and will continue to have relevance as long as philosophy is alive. This article only focuses on a limited time period and on a limited field of study (philosophy of science). Nevertheless, the historical survey presented here is rather extended, stretching from the 1920s to the 1990s. The reason is that it is necessary to trace the development of the specific themes in a sufficiently broad range of examples in order to illustrate the three main positions mentioned above. At the same time, to avoid excessive extension of the historical part, the more recent decades are not taken into account. (In the process, however, the most prominent contemporary philosophers of science are considered).

The leading theoretical arguments in support of my analysis will take the following form. I will give a description of three viewpoints held in the humanist tradition in philosophy of science:

1. changes in frameworks occur in a way that is rather structured, constrained or pre-determined
2. changes in frameworks occur in a rather free and random manner
3. framework changes occur in a manner which is partially constrained and partially random.

In all these 'models', I will argue that change and constancy are not sufficiently integrated. In turn these positions, I suggest, are related to the two poles (nature and freedom) of the humanist ground motive. After formulating a hypothesis on the pre-theoretical foundations of these three positions, I will propose an alternative that follows the work of Stafleu (1987:153–157) in the reformational tradition. I will argue in favor of a position of patterned framework changes, in which change is neither completely random nor rigidly pre-determined, but always integrated with constancy.

The purpose of this article is to clarify how epistemic frameworks change and this is intended to provide the basis for further studies into the *factors* that influence these changes. Furthermore, it may facilitate dialogue between two

1. The 'coherents' refer to an ontology of modal aspects (or modes of being) of temporal reality. Dooyeweerd (1979:40–41) distinguishes between fifteen modalities (the numerical, spatial, kinematic, physical, biotic, psychical, logical, historical, lingual, social, economic, aesthetic, judicial, ethical and certitudinal) which are irreducible to each other, but none the less display an analogical coherence. The mutual relationships between the aspects can be seen in the form of anticipations (where one aspect refers to another aspect later in the modal order) and retrocipations (where an aspect refers to another aspect earlier in the modal order). As an example of retrocipation, consider the concept 'economical pressure': here the economical aspect refers backwards to the physical aspect.

traditions (humanist and reformational) that proceed from rather different starting points. Let us begin by considering the way in which scientific development was conceived by supporters of the Received View of science.

Patterned or constrained change

Cumulative changes in the Received View

According to Suppe (1974:3), during the 1920s philosophers of science construed scientific theories as 'axiomatic calculi' which were given 'partial observational interpretation by means of correspondence rules'. This analysis (referred to as the Received View) was a product of logical positivism and was to be understood according to the basic tenets of the latter movement (Suppe 1974:6).

Suppe states that the Received View goes hand in hand with a view of scientific development, known as the *thesis of development by reduction* in that the former is presupposed by the latter (Suppe 1974:56). According to this view, scientific theories (when highly confirmed) are accepted as relatively free from the threat of future disconfirmation (Suppe 1974). This means that development in science is supposed to take the following form:

1. confirmed theories are extended to have a greater scope
2. new highly confirmed theories are developed for related domains
3. confirmed theories are incorporated into comprehensive theories (pp. 55–56).

This causes scientific progress to be regarded as a 'cumulative enterprise, extending and augmenting old successes with new successes' and furthermore, 'old theories are not rejected or abandoned once they have been accepted; they are just superseded by more comprehensive theories to which they are reduced' (Suppe 1974:56). This can be regarded as an example of constrained or patterned change. Against this background we can now consider the views of Gerald Holton, who believes that framework changes follow at least recurrent and persistent 'themes'.

Holton and persistent themata

Holton (1978:8) finds that scientific concepts, methods, propositions or hypotheses contain elements that function as 'themata' in constraining, motivating, guiding or even polarising scientific research and scientists (as individuals or communities). These themata (often not explicitly stated in scientific work) can have three different uses: as thematic concept (e.g. the application of the concept of 'symmetry' or of 'continuum'), as methodological thema (e.g. the preference for expressing the laws of science in 'constancies', 'extrema' or 'impotency') and as thematic proposition or thematic hypothesis (e.g. overarching statements like the two principles of special relativity) (Holton 1978:9).

Some of Holton's more interesting findings seem to be that themata occur in 'antithetical couples' (e.g. evolution and devolution, constancy and simplicity, reductionism and holism, hierarchy and unity etc.) and that this seems to be related to the 'dialectical nature of science as a public, consensus-seeking activity' (Holton 1978:10). Moreover, according to Holton (1978:10) the amount of themata (as singlets, doublets or triplets) is very small, with new additions being very rare. This means that themata are ancient and persistent (Holton 1978:10) and that old themata fare very well in newly elaborated contexts.

The existence of themata appears to give scientific frameworks some constant identity through growth and changes, even in the most radical advances (Holton 1978:10–11). In contrast to Holton, however, some authors in the philosophy of science seem to occupy a middle position between constrained changes and more random framework changes. In the next section, we will investigate the views of Karl Popper.

The 'middle position'

Karl Popper: Changes through conjectures and refutations

For Popper, changes in scientific frameworks cannot be sufficiently explained by the psychological propensity of the individual scientist (Popper 1961:154). Because science is practiced socially (rather than individually) the result can be a free competition of ideas which will eventually lead to progressive scientific change (Popper 1961:154–155). Of course, this proliferation of many different hypotheses necessitates rigorous methods of testing and falsification.

By 'conjectures and refutations' scientists can learn from their mistakes through mutual criticism (Popper 1963:vii; cf. 1979:260–261). Refuted theories become stepping stones towards improved knowledge and by repeated refutations the most corroborated scientific theories gradually approach the truth (Popper 1963:245). This means that, for Popper, changes in scientific frameworks occur in a way that is rather gradual, in the sense of a continuous reform of weaker theories. It is important to note that this 'linear' growth does not occur automatically (driven by some internal force in the development of science) but is rather the result of a laborious process of falsification (Popper 1963:365). Furthermore, the surviving theories should not be considered as having reached any kind of ultimate truth, because the 'elimination of a finite number of such explanations cannot reduce the infinity of the surviving possible explanations' (Popper 1979:264–265). Perhaps it is only natural for Popper (1996:1) to describe scientific changes from an 'evolutionary' perspective, through a kind of analogy of natural selection.

For Popper (1996) three levels of adaptation have something fundamental in common:

1. genetic adaptation
2. adaptive behavioural learning
3. scientific discovery (pp. 2–3).

On all three levels, progress starts from an 'inherited structure' and on the scientific level this corresponds to the dominant scientific conjectures and theories (Popper 1996:3). On all levels, the structure is transmitted through instruction and, on the scientific level specifically, by social tradition and imitation (Popper 1996:3). On all three levels the instruction comes from within the structure and changes on the scientific level will become new instructions that continue to arise from within (Popper 1996:3). When the instructions are exposed to 'environmental pressures', for instance theoretical problems, they are changed by processes which are partly random and, on the scientific level, become new and revolutionary tentative theories (Popper 1996:3). For Popper, scientific change is thus partly originating from within (and therefore partly constrained) and at least partly random.

Furthermore, the next stage of scientific change involves a process of 'selection' or a stage of elimination of error (Popper 1996:3). For Popper (1996:3) this natural selection is a kind of negative feedback on all three levels. This selection process will never reach an equilibrium state, as no perfect or optimal trial solution is likely to be found and because new instructions that emerge will, in turn, effect change in the environment (Popper 1996:4). On the scientific level, such environmental changes occur, for example, when new conjectures open up new and unexpected problems (Popper 1996:4).

The scientific level, however, differs from both the genetic and behavioural levels, by being more creative and revolutionary (Popper 1996:6). Scientific theories are formulated linguistically and duly become 'objects outside of ourselves' which can subsequently be subjected to criticism (Popper 1996:6–7). The linguistic nature of theories imbues scientific discovery with the creative imagination of 'explanatory story-telling, myth making and poetic imagination' (Popper 1996:7). What this means for changes in scientific frameworks, is that changes are the result of both conservative, traditional or historical elements, as well as more revolutionary or critical elements. Scientific change, although somewhat evolutionary, also displays a linear pattern. In the end, it is 'pattern' which gets the priority: in fact, refuted theories become 'stepping stones' towards 'better' theories, in continuity with the evolutionary line (Popper 1963:243–245). In the next section, another example of an author adopting a 'middle position' is investigated.

Can framework changes perhaps be predicted? Imre Lakatos

According to Lakatos, great scientific achievements should not be considered as isolated theories, but rather as 'research programmes', to be evaluated in terms of 'progressive' or 'degenerating' problemshifts[2] (Lakatos 1978:110). Scientific change occurs when research programmes supersede each other, that is, one research programme overtakes another in terms of progress (Lakatos 1978:110). Because it is conventionally acceptable to retain 'spatio-temporally singular factual statements', as well as 'spatio-temporally universal theories', some continuity is present within scientific change (Lakatos 1978:110). Such continuity evolves from research programmes, which consists of methodological rules instructing scientists on what research paths to take up ('positive heuristic') or to avoid ('negative heuristic') (Lakatos 1970:132).

Lakatos's research programmes are further characterised by their 'hard core' which is considered by provisional decision to be irrefutable and which defines problems, foresees anomalies and turns them victoriously into examples, all according to plan (1978:110–111). The hard core of the research programme further outlines the construction of a belt of auxiliary hypotheses which forms the 'protective belt' of the research programme (Lakatos 1978:110). According to Lakatos (1970:133) it is the protective belt which gets tested, re-adjusted and even replaced in order to defend the thus hardened core.

It is interesting to note that, for Lakatos (1970:132), both the positive and negative heuristic indicate (implicitly) the conceptual framework and language of scientific research programmes. This may mean that, in Lakatos's epistemic model, continuity is not linked to the structural order for reality[3], but rather seated in the knowing (human) subject. Scientific change, however, is not simply arbitrary but follows somewhat predictable 'methodological rules'. In this sense one may say that even in Lakatos's moderate position 'pattern' retains some priority over randomness.

The authors mentioned in the following sections, however, detect more 'freedom' in framework changes.

Unconstrained change

Thomas Kuhn: changes in normal and revolutionary science

In *The structure of scientific revolutions* (1970a) Thomas Kuhn describes scientific change in terms of two distinct phases of science, namely normal and revolutionary science. In the case of normal science, scientists are not aiming explicitly at innovation and therefore change is very limited. The changes are determined by a community of scientists working under the same epistemic framework. According to Kuhn (1970a:168), the members of the group have shared training and experience and, as such, are the 'sole possessors of the rules of the game or of some equivalent basis for unequivocal judgments'. This means that the scientific community will decide which changes are acceptable under their shared paradigm. Their judgment will be in favour of changes that are aligned with the accepted theories. For Kuhn (1970b:246; 1970c:4–5) the aim of normal science amounts to 'puzzle-solving'. During normal scientific practice the

2. For Lakatos (1978:112) a research programme is progressive when its theoretical growth anticipates its empirical growth, that is, when novel facts are successfully predicted ('progressive problemshift'). Degenerating problemshifts occur when the theoretical growth of the research programme cannot keep up with its empirical growth and it only gives post hoc explanations of chance discoveries or discoveries anticipated and made by rival programmes. In this case, the research programme is said to be 'stagnating'.

3. In using the phrase 'structural order for reality', I follow the distinction made by Hart (1984:38, 85). According to Hart the order *for* reality refers to 'the order of conditions to which the empirical world conforms'. This can be contrasted with the order *of* reality, referring to the 'experienced world of subjective existence'. As such, the structural order *for* reality conditions scientific thought, since science investigates a 'system of universality' holding for the world of individual existence (Hart 1984:38; cf. Coletto 2007:7).

premises of the ruling paradigm will define the puzzles to be solved, guarantee that the puzzles are indeed solvable and determine when a suitable solution is reached. This means that the changes in normal science will be 'cumulative' in the sense that they are merely further elaborations of accepted theories, as new puzzles will be solved with 'conceptual and instrumental techniques close to those already in existence' (Kuhn 1970a:96).

As in the normal phase of science the changes continue to share the premises of the paradigm and add to the collective achievements of the scientific community, they are viewed (by the particular scientific community) as constituting progress (Kuhn 1970a:162–163). However, Kuhn (1970a:163), in quoting Max Planck, states that in the end progress in normal science is 'simply in the eye of the beholder'. It is important to note, of course, that this 'beholder' is not simply an individual scientist, but rather a community of scientists reaching consensus.

According to Kuhn (1970b:247), normal science progresses because the community of scientists can take an accepted theory for granted (rather than criticise it) and can explore it to almost 'esoteric depth and detail otherwise unimaginable'. Because this in-depth exploration is bound to uncover anomalies, normal science will ultimately take a critical turn into what Kuhn terms 'revolutionary science'. A brief look at this fundamental phase of Kuhnian science is necessary.

In revolutionary science, changes occur in terms of replacing one paradigm with another, after 'nature itself' has undermined the professional security and has problematised the prior achievements of the scientific community (Kuhn 1970a:169). The alternative (i.e. new) paradigm will only be embraced by the community if it has the potential to resolve generally recognised problems and if it preserves a large part of the concrete puzzle-solving ability of the old paradigm (Kuhn 1970a:169).

Despite its improved puzzle-solving ability, the new paradigm is not a better representation of what nature is really like (Kuhn 1970a:206). Contrary to Popper, this means that successive paradigms do not increasingly approach the truth (Kuhn 1970a:170).[4] This lack of an ultimate goal in scientific revolutions, has led Kuhn to dwindle between revolution and evolution, in his choice of terms, to describe the nature of paradigm changes. According to Kuhn (1970a):

> The net result of a sequence of such [*revolutionary selections*], separated by periods of normal research, is the wonderfully [*adapted*] set of instruments we call modern scientific knowledge. Successive stages in that developmental process are marked by an increase in articulation and [*specialisation*]. And the entire process may have occurred, as we now suppose biological [*evolution*] did, without benefit of a set goal, a permanent fixed scientific truth, of which each stage in the [*development*] of scientific knowledge is a better exemplar. (pp. 172–173)

4. For Kuhn, 'truth' in this case refers to the ontological match between the postulated entities and that which is really out there and since there is no theory-independent way to understand what is out there, the idea of truth as such (for Kuhn) becomes 'illusive in principle' (Kuhn 1970a:206).

Furthermore, because paradigm changes do not imply directed ontological development, scientific revolutions are 'non-cumulative' (Kuhn 1970a:92). These characteristics of paradigm changes could easily be interpreted in a manner that would make change rather unconstrained.

Evaluation of Kuhn's views

According to Lakatos (1970:178–180; cf. 140 fn. 3), the Kuhnian view of scientific change implies that there are very few logical reasons for revolutions, but many psychological ones. When a Kuhnian paradigm comes into 'crisis', this denotes (for Lakatos 1970:178) a psychological state of 'contagious panic'. Furthermore, the new paradigm will be incommensurable with the previous one (each containing its own standards) and there will be no supra-paradigmatic rational standards with which to compare them (Lakatos 1970:178).

Kuhn's insistence on the role of the scientific community in paradigm-choice, has further led Lakatos to describe Kuhnian paradigm change as causing a 'bandwagon effect' which will eventually become a 'mob rule' as individual scientists imitate the great scientists by submission to the collective wisdom of the community (Lakatos 1970:178–179). I agree with Lakatos's interpretation: Kuhnian revolutions may eventually be the result of propaganda or rhetorical persuasion.[5]

For Kuhn (1970a:94) the circular argument (presupposing a paradigm whilst arguing for its defence) is indeed an effective form of persuasion in a scientific community, leading to a form of assent that is rhetorical (and therefore not logically or even probabilistically given).

To summarise, Kuhn clearly has two different sides to his conceptions of change in scientific frameworks: considering revolutionary science, paradigm changes are rather unconstrained. But we also have periods of normal science, during which changes in frameworks are 'linear', 'additive' or 'cumulative' (Kuhn 1970a:52–53; 96; cf. 1970b:250). Therefore, Kuhn may be seen as holding a rather moderate position amongst authors who consider changes to be rather free and unconstrained. Although Kuhn regards it as incorrect to describe his position as a form of relativism, he leaves the door open for partial relativism.[6] One of the most prominent figures to step through this open door was Paul Feyerabend.

Paul Feyerabend and methodological anarchy

For Feyerabend, the dynamics of scientific change are the result of the interplay of two principles, namely 'proliferation and tenacity' (Feyerabend 1970:210). Scientists must be allowed to 'introduce new ideas even when popular views

5. In partial defence of Kuhn, it should be noted that he does not simply propose that might makes right in the sciences, and that scientists are the victims of a history rewritten by the powers that be, since the special nature of scientific communities qualifies them for arbitration of professional matters (Kuhn 1970a:167).

6. Kuhn (1970b:264–266) states: 'In one sense of the term I may be a relativist, in a more essential one I am not.' In the first sense Kuhn refers to his view of scientific development as being fundamentally evolving, unidirectional and irreversible, which results in some scientific theories being considered better than others. In the second sense, Kuhn refers to his view that truth is a term with only intra-theoretic applications, which results in certain scientific theories being no better than others in representing what is really 'out there' in nature.

should appear to be fully justified and without blemish' and at the same time have the right to 'retain ideas in the face of difficulties' (Feyerabend 1970:210). Noteworthy are the undertows of subjectivism and relativism[7] in Feyerabend's understanding of the principles.

With regards to 'proliferation', Feyerabend (1970:210) seems to support relativism by stating that people should be able to follow their inclinations and that 'there is no need to suppress even the most outlandish product of the human brain'. With his view of 'tenacity', Feyerabend subscribes to a form of subjectivism, where 'one is encouraged not just to follow one's inclinations, but to develop them further' and to employ criticism (in the form of comparison with existing alternatives) in order to strengthen one's own views (Feyerabend 1970:210). According to Feyerabend (1970:210), however, both proliferation and tenacity support the ultimate aim of science: '*…happiness and the full development of an individual human being is now as ever the highest possible value*' [italics inserted by author]

To reach this highest possible aim, Feyerabend (1975:29–32) advises us to proceed in a counter-inductive manner. Without 'chaos', no knowledge and no progressive change will be possible (Feyerabend 1975:179). The reason for this approach is that any fixed method rests on a too limited view of the complexity of the human condition (Feyerabend 1975:27). The freedom of the individual is elevated to a point where it is to be fully unconstrained. The scientist is therefore free (like the sophists of antiquity) to defend different ideas in different circumstances, to hold no idea and all ideas at the same time. According to Feyerabend (1975:189), the scientist may change his views 'as a result of argument, or of boredom, or of a conversion experience, or to impress a mistress, and so on'. In the end, the only principle for epistemic change that Feyerabend (1975:28) is willing to defend, is 'anything goes'.

For Feyerabend, changes in scientific frameworks are therefore not guided by well-defined programmes (because the anarchistic method contains the conditions for the realisation of all possible programmes), but change is rather guided by 'vague urges' or 'passion' (Feyerabend 1975:26). In the wake of Feyerabend (though in a more moderate spirit) more authors seem to agree that changes in frameworks occur in a manner that is rather free and random.

Change after Feyerabend

Although it is certainly not the only trend after Feyerabend, some authors do continue in the vein of unpredictability of change (though in a more moderate spirit). For Lyotard science, as a kind of 'language game', cannot yield certain knowledge (Lyotard 1984:38–39). In this language game, scientific knowledge is constantly reduplicated, that is, 'citing its own statements in a second-level discourse (autonymy) that functions to legitimate them'[8] (Lyotard 1984:38). According to Lyotard (1984), the need for legitimation itself causes a process of delegitimation:

> There is an erosion at work inside the speculative game [of science], and by loosening the weave of the encyclopedic net in which each science has to find its place, it eventually sets them free. (p. 39)

This 'internal erosion of the legitimacy principle of knowledge' has the result of creating a 'constant flux' of areas of enquiry (Lyotard 1984:39). This causes a crisis in scientific knowledge. Apart from not being able to legitimise itself, the game of science has no special authority over any other game, because (although each kind of game has its own set of rules) all games are on par with the others (Lyotard 1984:40). In the end, for Lyotard (1984:41) only 'language practice' and 'communicational interaction' provide some legitimation. Postmodern science focuses on 'undecidables', on the limits of precise control, on catastrophes, paradoxes and other related subjects , and this causes evolution in science to be 'non-rectifiable' and 'paradoxical' (Lyotard 1984:60).

Richard Rorty seems to agree that truth is 'a property of linguistic entities' and that these languages are made by us, rather than found in the world (Rorty 1990:7). This means that the world cannot tell us what language game to play (Rorty 1990:7). However, Rorty does not simply substitute objective criteria for the choice of language game with subjective criteria (Rorty 1990:7). For Rorty, changes in language games are not the result of conscious decisions, but rather the result of the loss or acquisition of 'habits' in using certain words. It would seem as if, in Rorty's model, changes in scientific frameworks are the result of customs of vocabulary.

Further examples of authors who emphasise freedom of change in a postmodern climate could be included (e.g. Bloor, Barnes, Collins and other 'social constructivists'), but I will have to stop here. This brings us to the end of this historical overview and in the next section I will propose a transcendental criticism of the polarisation described in the previous sections.

At the roots of constrained and random change

A reformational hypothesis

We have seen that several authors regard changes in pre-scientific and scientific frameworks as being either free and random or quite constrained. In some cases, a synthesis of the two views is attempted. In most cases, however, the *integration* of constancy and change does not seem to emerge either clearly or sufficiently. This is obviously the case with

7.Subjectivism and relativism are not always equated to each other (as in Bernstein 1985). According to Van der Walt (2008:66–67) the tendency to emphasise the human subject (subjectivism) as well as the cultural situation and historical change, in terms of worldviews, can lead to the more radical view of 'so many views so many worlds' (relativism). Relativism can thus be regarded as a possible consequence of subjectivism.

8.The problem of 'legitimation' is borrowed from Habermas (e.g. 1976) and remains prominent in recent philosophy (cf. Coletto 2007), for example in Lyotard. The quest for legitimation can be regarded as an attempt at identifying an authoritative foundation for politics, ethics or (*in casu*) science (the three spheres distinguished by Kant and accepted by Habermas). Lyotard rejects legitimation by meta-narrative (e.g. Habermas's 'emancipation') and argues that *petit recits* (small narratives) are all one can rely on.

the two opposite models, because either change or constancy is given primacy. But even in the 'middle positions', change and constancy are juxtaposed or balanced, rather than integrated.

Should one attempt to penetrate into the deeper reasons behind this state of affairs? The following hypothesis can be advanced from a Dooyeweerdian point of view. Herman Dooyeweerd does not discuss the authors mentioned in this article, but he (1979:148–188) describes the consequences of certain pre-theoretical dynamics and mechanisms for culture in general. He (1979:15–16) recognises a religious driving force at work in humanist culture, which he terms the 'nature-freedom' ground motive. The nature-pole is rooted in the orderliness of concrete reality (conceived rather deterministically) whilst the freedom-pole is rooted in the unconstrained human personality. In *Roots of western culture*, Dooyeweerd (1979) describes the modern humanist emphasis on the freedom of the human personality and the view of 'nature' consequently adopted. Nature becomes:

> an expansive arena for the explorations of his (sic) free personality, as a field of infinite possibilities in which the sovereignty of human personality must be revealed by a complete *mastery* of the phenomena of nature. (p. 50)

By contrast, the 'nature' pole of the ground motive (which prevailed until the 18th century) implied a mechanistic view of nature and the adoption of the natural-scientific method (with its faith in the power of reason and progress). This ideal of science tried to include all of reality in a chain of causes and effects inspired by physics and leading to the division of complex phenomena into their simplest 'elements' (Dooyeweerd 1979:183). This became the new scientific method, granting the elimination of prejudice and speculation. In this perspective, nothing can be accepted as 'truly real if it does not fit into this chain of mechanical cause and effect' (Dooyeweerd 1979:153). Ironically, however, it soon became apparent that this 'chain' left no freedom for the human being itself (regarded as a part of nature and therefore also causally determined). Nature and freedom, therefore, threaten each other: either humans 'abolish' nature, or nature abolishes humans. In between these extremes, there are recurring attempts at 'reconciling' the two poles in a sort of middle position.

In the 19th century the shift to the freedom-pole inspired a new scientific method inclined to a 'new universalism', which led to an attempt at understanding the 'peculiar place and function of the parts in terms of the whole' and focused on the individuality of phenomena (Dooyeweerd 1979:182–183). This was particularly suited to the science of history and, thus, historicism was enthroned as the new scientific method (Dooyeweerd 1979:184). Dooyeweerd closely associates historicism and relativism. In his (1979:151) opinion the historicism of the freedom pole did not permit scientific thought to recognise a given structural (i.e. creational) order[9], thus causing the *locus* of order to be (mis)placed in the human knowing subject. One of the consequences was that the notion of scientific truth became rather relativised.[10] Summing up, the two poles of the humanist ground motive move in two different directions. The one leads to a constrained, patterned, even determined world, the other leads towards a world of unconstrained freedom and unpredictable developments. As science and its developments are part of this world, they are (intuitively) regarded as constrained or un-constrained, depending on the pole attracting the scholar's trust.

The humanist ground motive and framework changes

From this point of view, the authors examined above can all be placed on a continuum between the two extremes of the nature-freedom ground motive. It should be noted that, historically speaking, we meet, firstly, the authors relying on 'determined' change, secondly, the middle position and, thirdly, the option of unconstrained change emerges. Authors such as Holton may be considered closer to the nature-pole, whilst Popper and Lakatos occupy positions that can be considered fairly centralised between the two extremes. Feyerabend, Lyotard and Rorty tend towards the freedom pole. Kuhn also belongs to the latter group, but seems to be more moderate in his position. What all of these authors have in common, however, is that their positions all depend on a dialectical (pre-theoretical) starting point.

In the case of dialectical ground motives, two 'spiritually charged' poles exist within a single ground motive (Dooyeweerd 1979:12). The resulting dialectic is characterised by an absolutisation of part of created reality, which necessarily calls forth the correlates of what has been absolutised (Dooyeweerd 1979:13). Dooyeweerd explains that an absolutisation of something which is relative will, in the long run, lead to an absolutisation of its 'opposite' or 'counterpart', because all parts of creation are necessarily related to each other. Such a religious dialectic can never be synthesised into a higher union, because no higher point than the absolute exists.

This dialectic generates a kind of 'pendulum dynamic' driving theoretical thinking from one pole to the other in its attempt to rid itself of this correlativity. According to Dooyeweerd (1979:13) the effect of the pendulum dynamic is that priority or primacy is alternatively attributed to one of the two poles, whilst simultaneously depreciating its opposite. Attempts at synthesis are also performed and can be observed in authors who attempt to hold a middle position between the two extremes. As a result of the powerful dialectical dynamics at work, however, such attempts are usually short-lived, genuine integration cannot be achieved and the pendulum quickly moves to the next pole.

What has been presented here is a hypothesis aimed at understanding and penetrating to the roots of the three main positions concerning framework change, presented

9. With 'given creation order', Dooyeweerd refers to the structure for reality (cf. fn 1 above).

10. As Strauss (2005:225) points out, historicism taken to the extreme ('everything is history') becomes unthinkable ('there is nothing left which can have a history'). More radical consequences of this cultural movement include nihilistic tendencies, for example, in the works of Nietzsche, Dilthey, Spengler and Schelling (Dooyeweerd 1980:81; 111).

in the previous sections. Some readers might consider that such a hypothesis would require substantiation by further evidence, taking into account the complex developments of each author's philosophy. All this cannot be offered within a single article: here I can only indicate, as a modest contribution, a direction for further research. This hypothesis, however, is not indispensable or even necessary[11] to proceed to our next step, namely the search for a model in which change and constancy are better integrated. The main reason for this search is that the models already explored may not be regarded as fully satisfactory. In fact, change and constancy could not be properly integrated, even though in some cases they appear as somehow 'balanced'.

As an alternative to this polarisation, it may be worthwhile to consider authors who proceed from a non-dialectical starting point. A model may be regarded as non-dialectical when it is rooted in a ground motive which does not present dialectical traits (cf. Dooyeweerd 1979:11–14). According to Dooyeweerd, the Christian biblical ground motive of creation, fall and redemption should be regarded as non-dialectical. This is the basis on which Dooyeweerd's work developed, and on which Marinus Stafleu (1987:153–157) has developed a model to account for the scientific enterprise.[12]

In the next section, it will be necessary to briefly explain Stafleu's view of science in general, before moving to the more specific question concerning the nature of change in scientific frameworks.

Marinus Stafleu

A multidimensional model for framework changes

In Stafleu's model the notion of *law* is prominent. The aim of the scientific enterprise is defined as: 'the opening up of the law-side of nature'; and the 'discovery and development of law-conformity in reality' (Stafleu 1987:152). Furthermore, his definition of objectivity reads as follows: 'not conformity of theory to fact, but law-conformity' (Stafleu 1987:241). This has a normative consequence: 'investigation of the lawfulness of the creation is conducted by respect for the laws, or rather for the law-giver, the Sovereign of heaven and earth' and further 'it means the subordination of human thought to divine law' (Stafleu 1987:241). The laws are not merely 'descriptive', but also 'prescriptive' (Stafleu 1987:153). This is an attempt at escaping the subject-object dilemma described above by introducing a dimension (the law, and the structural order) which was often recommended by Van Riessen (1992:54–55) as the most suitable 'anchorage' for scientific research.

Stafleu's (1987) model outlines three basic dimensions (or coordinates) which show that research is not a linear process, but is multidimensional:

1. the distinction between the 'law-side' and the 'subject-side' (all of which is subjected to the law)[13] of nature
2. the distinction between 'universal' and 'typical' modes of being or experience
3. the distinction between the various (irreducible) aspects of human experience[14] (pp. 153–154).

Regarding the scientific inquiry, each of the three dimensions is connected with two pairs of directions of research (Stafleu 1987:154):

1. We can note that induction is directed toward the law-side whilst deduction is directed towards the subject-side.
2. The search for unity is directed to the universal, whilst the search for structure is directed to the typical.
3. Lastly, with regards to the search for applications is determined by anticipations, whilst the search for objectivity is determined by retrocipations (pp. 154–156).

According to Stafleu (1979:15ff) this manifests as a certain pattern in the history of science: a field of science becomes 'isolated' from other fields and subsequently it becomes possible to 'develop' the field, for example to 'design a mathematical framework', to 'relate' it to other fields or to 'apply' it to technical problems.

Stafleu (1979) recognises that this process occurs in various phases:

1. An orientation stage characterised by more or less uncoordinated observations and speculative explanations (roughly corresponding to Kuhn's pre-paradigm phase).
2. A period of 'isolation', during which the specific concepts and problems of the field are distinguished from those of other fields. Although there is no generally accepted theory (as Kuhn would argue) authoritative scientific works appear, summarising the properties and phenomena characterising a certain field.[15] (This phase roughly corresponds to what Kuhn would regard as the acquisition of the first paradigm).
3. Furthermore, what Kuhn would call paradigm-shifts are explained by Stafleu as the discovery of both retrocipatory and anticipatory analogies. This happened for example during the phase of 'mathematization' of physics, when the numerical modal aspect shed light on physical phenomena. (p. 15ff)

The model can therefore be used to explain what happens when changes occur in scientific frameworks. In what follows, the term 'multi-dimensional', which I proposed, is enriched by the connotation of 'multi-modal'.

11. The Dooyeweerdian hypothesis is also not the only one that could be employed for the aim of exploring the dialectical conflict discussed above. Similar conclusions might be reached by referring for example to Bernstein's (1985) conflict ('agon') between objectivism and relativism or by utilising Visagie's (1996) 'macromotives' and the type of 'emotive logic' that they generate.

12. A detailed discussion of the connections between the Christian-biblical ground motive and the concrete proposals and tenets of reformational philosophy would be too complex to be (re)proposed here. For an introduction to this topic see for example Hart (1984:325–370).

13. Stafleu regards as subjected to the law both the (knowing human) subject and the object of knowledge. Simply stated, 'all things, events and relations are subjected to laws' (Stafleu 1987:153).

14. For a list of the 'aspects' of human experience, cf. fn. 1 above. According to Stafleu (1987:154), the aspects are related to each other because: (1) 'they show a linear order' which can be indicated as referring forward (anticipations) or backward (retrocipations) and (2) each aspect refers to the other aspects.

15. Stafleu (1979:15ff) demonstrates this pattern in the history of science, in dialogue with Kuhn, by using examples from studies of electricity and magnetism: William Gilbert gave a summary of magnetism in 1600, separating the two fields from each other and in 1733 Charles Du Fay developed a defining summary for studies of electricity (Stafleu 1979:15ff).

Constancy and change in framework changes

Stafleu argues that during the opening-up process meaning is both deepened and relativised (Stafleu 1980:26) (In the latter case, especially, the discoveries can be truly spectacular). This means that framework changes are not only 'revolutionary', but also follow persistent 'themes' (to use Holton's language). In fact, the modal aspect in question remains the same (as a fundamental and irreducible mode of explanation), but at the same time it is not exactly the same anymore, as it is 'opened up' by modal analogies (Stafleu 1980:26). Change and constancy are therefore deeply integrated. From this point of view, the fact that both revolutionary change and persistent 'themes' were discovered in the history of science becomes quite understandable (Stafleu 1980:27).

This model also implies that changes in epistemic frameworks occur according to a pattern, neither completely random nor rigidly constrained, which results in change being dynamic but not arbitrary. Because the model is based on a non-dialectical motive, change and constancy are more integrated and coherent, in a way that is not always possible even in the most 'centralized' positions examined above. For example, Kuhn has change especially in one (the revolutionary) phase of science and constancy in another (normal science). Popper and Lakatos may be regarded as having a more integrated approach and this may be appreciated. However, if the (reformational) hypothesis that they are attempting an unlikely synthesis is plausible, one would expect that their attempt would be rapidly followed by more polarised positions (in this case in the historicist direction). Historically speaking, this is precisely what happened.

Stafleu's model deals particularly with changes in special-scientific frameworks. Regarding the pre-theoretical frameworks, other authors in the reformational tradition have developed some valuable perspectives. As already mentioned, Dooyeweerd (1979:11–14) describes a 'pendulum' dynamic between opposing poles of a religious ground motive, giving some structure to changes, whilst with philosophy the problem-historical method of Vollenhoven (2005:113; 114) suggests some interaction between 'types' and 'time currents' in such a way that 'types' are changed by each new time period. An explication of the latter method is beyond the scope of the current article, but is well worth investigating (cf. Vollenhoven 2005:95ff).

Conclusion

Since the recognition of the existence and role of pre-scientific epistemic frameworks in philosophy of science, three main approaches to framework change have been detected. The first approach regards changes in frameworks as occurring in a way that is rather constrained, predictable and even according to a pre-determined pattern. The second approach seems to argue that changes in frameworks occur in a way that is more random or unpredictable and free from constraints. In between these two views, a middle position is found that attempts a kind of synthesis between constancy and change.

The reformational approach sketched above would acknowledge the importance of the structural order for reality (in terms of the modal aspects) influencing changes in epistemic frameworks. By referring to both the irreducibility and cohesion of modal aspects, I have argued, it is possible to explain framework changes both in terms of continuity and revolutions, which result in changes being dynamic but also deeply integrated with constancy.

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