The Progress of Scientific Knowledge: Evolution, Revolution or Involution?

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"Progress lies simply in the eye of the beholder"
Thomas Kuhn (1970:163)

Samevatting

Hierdie artikel verken die oorsake van die verlies aan vertroue in die moontlikheid van wetenskaplike vooruitgang in die huidige humanistiese wetenskapsfilosofie. Eerstens, die geleidelike beweeg na pessimistiese en relativistiese sienings word geïllustreer aan die hand van 'n historiese oorsig. Die oorsake van hierdie situasie word dan verken: daar word geargumenteer dat die idee van vooruitgang geleidelik losgemaak is van die struktuur-orde vir die werklikheid. Laastens word 'n alternatiewe siening voorgestel, waarin begin word om die verlore skakel tussen vooruitgang en 'n wetsorde te herstel.

1. Basic orientation, problem statement and plan of action

One can be quite amazed while considering how, in the humanist tradition, the initial optimism towards scientific progress was gradually transformed into the contemporary disillusionment. No doubt both Descartes and Bacon had in mind a very linear type of progress. The right method would have provided an accumulation of data and observations granting the growth of scientific knowledge. The new theories would have explained new phenomena, while also explaining all phenomena already clarified by the older theories. It was a matter of accretion.

The Enlightenment confirmed this basic trust in science and progress and actually joined the two in indissoluble marriage. The positivist tradition continued to safeguard this marriage, and sharpened its methods to guarantee a continued accumulation of knowledge. Religion, in the opinion of many, was rapidly retreating in front of the triumphant march of science. Religion would have soon been chased away from its last shelters,

where the light of science was not yet shining in its fullness. It would be just a matter of time ...

But as the 19th century reached its last decades it started to be clear that industrialisation had heavy social, moral and psychological costs. Science started to show a face of abuse and exploitation. Together with some advantages, it brought about new threats of destruction; new weapons, while new diseases appeared. The world had not become a safer place to live in, on the contrary the 20th century knew sufferings of un-precedented scale and depth. In the two World Wars the most recent scientific achievements of the time were explored in view of a possible utilisation for military purposes. Could science perhaps even cause regress? In *Philosophy of science,* Popper started to discuss this possibility (1970:57-58) and even argued that it is easier for science to regress than to progress (1963:365). Kuhn (1970a:20-21) also asked the question whether it is not possible that contemporary scientists have more unanswered questions than those living in the 18th century, and therefore may be more "ignorant" than their predecessors.

The main questions of this article can be formulated as follows: *why has contemporary philosophy of science gradually lost confidence in the possibility of scientific progress? What could a Christian response to the present situation sound like?*

One should probably start by clarifying what is meant by "progress". Admittedly, in science there are several types of progress. One might refer e.g. to the various benefits brought about by new research and perhaps applied by new technologies. One might refer to economic and social advantages. All this, however, is somehow "external" to science. This article deals specifically with the "internal" (epistemological) progress of science, the "growth" of scientific knowledge.

In the first part of this article (sections 2-4) the author will illustrate the characteristics of the gradual loss of confidence in the idea of scientific progress in the contemporary philosophy of science. In this historical exploration he will focus especially on philosophers (a) that deal especially with philosophy of science, (b) that are (among) the most influential philosophers of science of the period in question and (c) whose philosophies are good examples of the themes he intends to substantiate.

The author will then look (section 5) for the possible reasons for the skeptic-pessimistic attitude towards progress. The diagnosis will focus on the relativist views of progress resulting from historicism. In the remaining part of the article (section 6) he will also delineate some reformational

notions that might counteract this drift towards pessimism. His main suggestion will be that progress in science does not occur randomly but is linked to the modal structures of reality. Scientific progress consists in the "opening up" of a field of science according to specific methods and criteria and in agreement with the purpose of science.

The author will start his historical survey from Karl Popper, a philosopher who still maintained a considerable dose of optimism about the progress of the scientific enterprise. This will provide a frame of reference against which the subsequent loss of confidence and the adoption of more pessimist and relativist views will become more apparent.

2. Introducing evolutionary progress: Karl Popper

2.1 Trials, errors and new trials

We meet Popper at the crossroads between the old and the new dispensations in philosophy of science. Popper rejects the cumulative view of epistemic growth which was typical of positivism and rationalism. Nevertheless, Popper maintains a rather confident view of scientific progress.

He does not believe in any "law of progress" directing the scientific enterprise from within. Actually, in his view "it is much easier for us to regress than to progress" (Popper, 1963:365) and the attempt at founding progress on some inborn (psychical or social) tendency of the human nature is totally misplaced (Popper, 1961:152-159). However, Popper's general view of science allows for the possibility of progress. The preface to his *Conjectures and refutations* is opened by the statement: "we can learn from our mistakes" (1963:vii). According to Popper, this is the central theme of the book.

We learn through criticism, according to Popper, by the "repeated overthrow of scientific theories" (Popper, 1963:215). The expression might make one think of a revolutionary process, similar to the one described by Kuhn. But this is not what Popper means. In his view, both in science and politics, progress is brought about by reform, not by revolution (1963:132). And here the *evolutionary* element comes to the fore. In Popper's view "trials and errors" occur at three different levels, and there are clear similarities (with differences) between them. At the biotic level this process concerns the evolution of organisms. At the behavioural level it concerns the adaptation to external conditions through a learning process. At the scientific level it concerns scientific discoveries (Popper, 1996:1-32). Here "trials and errors" become "conjectures and refutations".

According to Popper we can gradually approximate the truth. We can substitute old theories with new and better ones. We will never reach

absolute perfection, the truth or any final point, but we can progress. Progress is possible and is brought about by the application of the correct method: conjectures and refutations. The critical tradition, started by the Greeks (Popper, 1963:126), provides the perfect ground for the growth of scientific knowledge. Actually, science *must* grow, otherwise its "rational and empirical character" would vanish (1963:240 ff.). Growth is an essential characteristic of scientific knowledge.

What is the aim of scientific research? Concerning the natural sciences, their task is "the search for truth (...) for true theories" (1963:229). Popper specifies that we are not looking only for truth. "We want more than mere truth: what we look for is interesting truth (...) we want more truth and new truth" (Popper, 1963:229). We look, according to Popper, for answers to our *problems*. Only then research and conjectures become relevant for science.

What is truth then? Truth is "correspondence to the facts", as Tarski understood it (Popper, 1963:224). According to Popper both this specific view of truth and the idea of testability "can shed much light on the idea of progress" (1963:231). Can we approximate the truth more and more? Can we speak of better correspondence? Actually, according to Popper, we cannot do without this idea. And here the ideas of truth and testability of the content are combined into a third one: *the degree of correspondence to truth*, (in the sense of correspondence with the facts – cf. p. 231-233) or degree of verisimilitude (Popper, 1963:231-32). The latter is not to be confused with the idea of degree of probability (1963:236). Verisimilitude means rather truth-likeness. It is possible to establish whether a theory T1 has less verisimilitude than theory T2 (Popper, 1979:52) and in this way it is possible to establish which theory is closer to the truth.

Popper tends to see the refuted theories as "stepping-stones", as preparations to new theories. He does not really see them as "mistakes", as Kuhn (1970a:11-13) suggested (on the basis that Popper repeatedly speaks of learning from our *mistakes*). The main point, for Popper, remains approximation to the truth. All theories approximate the truth to a certain degree. A refuted theory is not only an instrument for pragmatic purposes, it is also a stepping stone towards the truth (Popper, 1963:245). Refutation is not a failure, but a form of progress: there is no progress without refutations (1963:243). Old theories are thus collocated in a linear path towards progress.[1]

1 Popper (1963:240) shows his wit by observing that when theories are refuted: *"de mortuis nil nisi bene"* (one should only speak positively of the dead).

With this, Popper has sketched his rather confident approach to the theme of progress. Yes, admits Popper (1963:216), the history of science is a history of obstinacy and error. Yet in science (perhaps only there) errors can be criticised. This is why we have progress. In other fields of human endeavour there is often change, but seldom progress.

2.2 Popper's view of progress

In conclusion, one could define Popper's view of scientific progress as "linear" (cf. Stafleu, 1987:152). However it is not linear in the same sense as the received view meant it. It contains an evolutionary element. The main direction, in the long run, is one of progress (the critical tradition constituting the constant basis). But there is also a continuous process of adjustment, small reformations implying the rejection of theories and the search for better ones. Scientific progress seems to reflect the biological evolution: the species are improved through the elimination of the weaker elements. Science does not just progress by itself, in a cumulative way. Nothing is automatic, on the contrary, progress is the result of a constant struggle.

Popper's view of progress also contains a pragmatic undertone. It does not promise that some ideal "truth" can be reached, but more modestly (and *usefully*), it allows practising, conjecturing and falsifying. The evolutionary line does not contain the possibility of reaching some final achievement or fulfilment point. Yet continued growth is granted, a process which is useful enough. In philosophy of science, however, the atmosphere was rapidly changing.

3. Introducing revolutionary progress: Thomas Kuhn

3.1 The purpose of science

In order to assess the eventual progress of scientific knowledge one needs to know its purpose. On this point, Kuhn is reproached by Feyerabend (1970:202) for not telling us about the aim of science. This might be the case in the specific instance mentioned by Feyerabend, yet it is possible to deduce Kuhn's view from his works. He starts by distinguishing the normal and the revolutionary phases of science. For normal science the aim is "puzzle-solving", while the aim of revolutions is something like "exploration" of new directions. There is an (early) instance when Kuhn mentions the two together and even says that (although their relationship is one of tension) they both characterise science (Kuhn, 1963:368). Knowing his answer to the question of the purpose of science, we should now ask: is there a possibility of progress in normal science? And is there progress from revolution to revolution?

3.2 Normal science and its progress in The Structure of Scientific Revolutions[2]

According to some of Kuhn's own statements in *The structure*, there is indeed progress in normal science and Kuhn defines it as "linear", "additive" or "cumulative" (Kuhn, 1970:52-53; 96. Cf. 1970b:250). Progress in normal science "seems both obvious and assured" (1970:163. Cf. also 1970b:245). In some instances, however, Kuhn seems to question his own admissions on this point. For example when he asks: who decides whether there is progress? Usually a certain community of scientists, those who determine the "rules of the game" (Kuhn, 1970:168). What else could they see? They work together under the same paradigm! (1970:162-163). But an external observer, who does not share the premises of the specific group might not see any progress (Kuhn, 1970:162).

However, the eventual lack of progress would not detract anything from the scientific character of a discipline. In fact, Kuhn does not accept Popper's view that progress is simply one of the most fundamental characteristics of science (Kuhn, 1970:162). Nowadays we even have difficulties, says Kuhn, in distinguishing science from technology, because they both show progress. On the other hand, we tend not to consider the humanities as full sciences because their progress is not so obvious (1970:160-161). Kuhn's question is penetrating: "does a field make progress because it is a science or is it a science because it makes progress?" (Kuhn, 1970:162).

It is especially revolutionary science, however, which is taken into account by Kuhn to clarify the nature of scientific progress. This is why a question like: "how are we to understand the way in which science does progress?" is placed right in the center of a discussion concerning revolutionary paradigm changes (Kuhn, 1970a:19).

3.3 Revolutionary science and its progress in The Structure of Scientific Revolutions

Is there progress in revolutionary science? Revolutions, Kuhn admits, are linked to some kind of evolutionary development. Progress from revolution to revolution cannot be totally denied. Scientific progress is not what we used to think it was, but it accompanies science (as Popper believed) as long as science is alive (Kuhn, 1970:170). And yet, says Kuhn

2 From now on *The Structure.*

(now in disagreement with Popper), paradigm changes do not carry scientists *closer* to the truth. New theories are better than the previous ones, but not in the sense that they *represent* nature better. Only in the sense that they are better instruments for puzzle-solving. In fact Newton improved on Aristotle and Einstein on Newton. But only insofar as they produced better instruments for puzzle-solving.[3] For the rest, says Kuhn (1970:206), there is "no coherent direction of ontological development". In some cases Einstein is closer to Aristotle than to Newton.

We can still, in this context, maintain the idea of evolution, provided there is no goal (Kuhn 1970:171). As Darwin eliminated the idea of a goal from natural selection, we should eliminate it from scientific development (Kuhn, 1970:172). We should learn, according to Kuhn, to consider evolution from its point of departure, rather than from its hypothetical goal. In science we have a selection of the fittest (paradigm) by revolution. Here Kuhn (1970:172) introduces the interesting idea of a "revolutionary selection". He had already associated *revolution and evolution* in previous passages (1970:92-93). For Popper the two ideas remain much more distinct, and probably opposed. It would be interesting to ask to what extent, from a philosophical point of view, the two ideas are compatible.

So, what remains of progress in revolutionary science? Some of Kuhn's statements are rather negative. Progress, like beauty, lies only "in the eye of the beholder": more or less an illusion (Kuhn, 1970:163). Revolutionary changes do not imply progress. Once again, it is those who have supported the revolution that recognise the progress (Kuhn, 1970:166, see also 169). What else can be expected from them? But in practice, revolutions are non-cumulative (Kuhn, 1970:92). The previous paradigm cannot be considered a mistake (1970:115) and its abandonment and substitution by a new paradigm cannot constitute progress.

3.4 Further development of Kuhn's views

In his writings after *The structure*, Kuhn did not introduce radically new elements in his view of progress. He "softened" the idea of radical fractures between revolutions by recognising more elements of continuity and comparability. But Kuhn also maintained and defended the existence of scientific revolutions and did not accept the attempt of some of his critics at pushing "the case for continuity too far" (Kuhn, 2000:56). If we

3 On this issue, one might observe a pragmatic undertone in Kuhn, similar to the one observed in Popper (see 2.2 above).

can speak of progress through revolutions, we can only point to better instruments for puzzle-solving (Kuhn, 1979:418). But no clear goal or itinerary should be envisaged and the idea of a gradual approximation to the truth should also be rejected (e.g. Kuhn, 2000:85-86).

3.5 Kuhn's view of progress: Towards an assessment

One can say that Kuhn's line of cultural progress resembles the one designed by Karl Marx: progress is granted by subsequent revolutionary phases. In Marxism, however, the goal and destination of progress is clearly indicated from the start. With Kuhn we have neither final goal nor clear direction. His view of progress is more similar to the one elaborated by Toynbee in his *A study of history* (Toynbee, 1935-1961). Each civilisation emerges, reaches its apex, and goes towards its decline. In its final phase, however, it contains in itself the seed of a new beginning. The new phase will be radically different, yet linked to the previous one in a seminal way. In some instances Kuhn seems to reject this continuity (between paradigms), but basically some form of continuity is admitted (cf. Kuhn, 1970:169). For both Toynbee and Kuhn no clear purpose or destination can be delineated.

In conclusion we can say that, in comparison to previous thinkers, the possibility of progress is further weakened in Kuhn. Basically, progress seems to be limited to an increased ability in puzzle-solving provided by each new paradigm. But it should be remembered that after each revolution there are losses as well, due to the abandonment of the previous paradigm. In general, there is no gradual approximation to the truth. As usual, an even more radical position is offered by Feyerabend.

4 Feyerabend and beyond: Involution?

4.1 Unmasking a few illusions about scientific progress

According to Feyerabend (1970:202), Kuhn fails to indicate the goal of science. But Feyerabend is in his turn reproached by Stafleu (1987:152), for the same reason! In fact, an explicit declaration on this topic is missing in Feyerabend's writings. One should not forget, however, that (while speaking about science) he says: "the happiness and the full development of an individual human being is now as ever the highest possible value" (Feyerabend 1970:210). One should not miss noticing, at this point, that the *aim of science* is gradually made more "modest" (and extra-scientific as well) by the authors we have examined thus far. Popper's "search for truth" is reduced by Kuhn to "puzzle-solving" and to Feyerabend's "happiness of the individual".

Feyerabend agrees with both Polanyi and Kuhn on the observation that progress (in this case "short-term": e.g. a new discovery) is not generated especially by rationality or by rational methods. According to Feyerabend science is the result of passions, of views that one wants to defend. It progresses by adjustments, *ad hoc* hypotheses and even unjustified resistance against refutations. Actually rationalism and empiricism end up preventing progress. Science progresses via errors and chaos. Without chaos there is no progress (Feyerabend, 1975:179). Progress is made possible by anarchism and by those who "unwittingly used this philosophy" (1975:190). We might advance science not by induction or deduction but proceeding counter-inductively: by developing hypotheses that are inconsistent with both established facts and theories (Feyerabend, 1975:29 ff.). Only in this way did (e.g.) the heliocentric theory emerge!

This can be considered Feyerabend's view of progress in the short term, in "normal science" so to speak. What about progress in the long run? Feyerabend does discuss the relationship between old and new theories. According to the "official" view the new theory incorporates in itself the "successes of the old theory", which become part of the truth content of the new theory. What are rejected are simply the failures of the old theory. But in the new theory we also have additional material: the new predictions which allow new research and development. All this, says Feyerabend (1975:174), is rather implausible.

In fact the relationship between the two theories follows a different model. The latter can be represented by two overlapping circles, symbolising the two theories. The intersection area represents "the problems and facts of the old theory which are still remembered and which have been distorted so as to fit into the new framework" (1975:178). For the rest, the two theories cover different areas and have nothing else in common.

It is an illusion, says Feyerabend (1975:178) "which is responsible for (...) the demand for increased content". The new theory does not increase, according to Feyerabend, the content of knowledge with respect to the previous one. We can still imagine a link between the two theories, but the content that the two theories have "in common" is distorted in order to fit in the new theory. The result is not progress, but proliferation.

According to Feyerabend this view of science is desirable, because it eliminates from the picture the arrogant claims of reason. In the same vein Feyerabend observes that progress has not been achieved only by western science and its rationalist methods. Western science is heavily indebted to the efforts of herbalists, alchemists, those who observed the stars in antiquity and so on. Are they also scientists? The author is not sure how

Feyerabend would answer this question, but he would probably say that they too achieved results. As the distinction between scientific and non-scientific is blurred in his system (Feyerabend, 1975:19), science cannot be neatly distinguished from other activities *achieving results* and providing satisfaction to individuals.[4]

4.2 Feyerabend and scientific progress: an evaluation

When Feyerabend's (1975:174-178) view of the relationship between the old and the new theory is considered carefully, it shows that progress (at least in the internal, epistemological sense), is not implied in the picture. He cannot join Kuhn in saying that "later scientific theories are better than earlier ones" (Kuhn, 1970:206). Progress and regress live side by side and sometimes they are not clearly identifiable. We are left with an assessment of the impact of science on society. Science can be said to progress or to regress according to its ability to promote the "development of the individual" (Feyerabend, 1970:210). The question is not: do we know more than yesterday? Is science at least solving its own puzzles better? The question is rather: "does it contribute to my satisfaction"? Is it "humanitarian"? The pragmatic undertone observed above in Popper and Kuhn, becomes a hedonistic undertone in Feyerabend.

However, even when this "external" measure is used, modern science is found by Feyerabend to be regressive. In his view modern science represents mostly an involution, with respect to previous achievements. This is due to the fact that modern science is no more humanitarian, it does not take into account social or psychological needs. It is rationalistic and sterile, depending on the myth of objective knowledge, which is enforced on everybody by the most undemocratic means.

A broad overview to see what the landscape looks like after Feyerabend, shows that the skeptic attitude towards progress has not changed much. On the contrary, it has often been expressed even in more radical terms. With Lyotard, for example, science is supposed to be involved in a continuous revolution, to deny again and again its achievements, to deal with un-decidables, to break down consensus and rather to look for dissension.

4 In appreciation of "ancient science" Feyerabend (1975:50) mentions Chinese traditional medicine, and also (1975:306) the study of the therapeutic effects of certain plants, the building of the pyramids, Polynesian travels, the astronomy developed in the old Stone Age, rotating agriculture and so on. It sounds like an indirect reply to Popper, who places in the "critical tradition" inaugurated in Greece the true origin of the scientific spirit.

Postmodern science theorises its own progress as catastrophic, non-rectifiable and paradoxical (Lyotard, 1984:60).

5. Why is progress doubted? Towards a diagnosis

5.1 Dooyeweerd: progress and the ideal of freedom

Dooyeweerd has attempted to analyse the complex reflection of humanist philosophy on historical and cultural progress. In this section the author will illustrate his basic approach to cultural progress in general while in the next one he will focus on the more specific topic of scientific progress.[5]

Basically, according to Dooyeweerd, the history of modern culture evidences a gradual loss of a sense of historical purpose and direction from the second half of the 19th century. The cultural movements taking as a starting-point the nature-pole of the humanistic ground motive usually adopted a more "progressivist" attitude, especially in politics. They also nurtured a robust faith in progress. Of course there are differences that should not be overlooked. Dooyeweerd (1984, 2:349-50) distinguishes for example between the 17th and the 18th centuries' Enlightenment. But in general the idea of a steady progress under the guidance of reason remained characteristic of the Enlightenment. On the contrary, the cultural movements inclined to the freedom motive (e.g. the "Restauration" in European politics and Romanticism in philosophy) have been rather conservative, and even reactionary in their most radical versions. They have attenuated and even rejected the faith in progress, by depreciating the ideal of science and the trust in reason.

Within the reformational tradition, those who prefer to characterise the humanistic ground motive as implying a dialectical tension between *nature and culture* can reach very similar conclusions. For example Venter (1999:14) argues that in the Enlightenment period "progress is the movement of history to ever higher levels of civilization; one could say it is the level of dominance of reason [i.e. culture] over nature". Concerning

5 Although there is a difference between a theory of general-cultural progress and one of scientific progress, the two are normally linked, at least for the simple reason that science is part of culture. They are also linked in one's pre-scientific view of progress. The latter is the reason why normally a thinker's theories of scientific progress are usually consistent with his/her theories of cultural progress in general and with theories of political or economic progress. For example, when Popper argues that scientific progress is achieved by reform rather than revolution, his statement refers to a basic pre-scientific conviction, which is then reflected in his political views as well (Popper, 1963:132).

the movements linked to the opposite pole, Venter (1999:23) argues: "the inversion of progress (the idea of a return to nature or the dominance of the natural) became stronger as irrationalism took hold. (...) in some cases this ended in a pessimistic atmosphere of decline (Spengler); in others in an activistic attempt to create progress (Pragmatism)".

Coming back to Dooyeweerd, the dialectics between nature and freedom is not that simple, of course. One must also consider the attempts at finding a synthesis between the two opposite poles, which occurred for example during the Romantic period. Then progress was welcomed under the control of the freedom-pole and regarded as causing an organic development of the free personality and of national communities. Progress could then be accepted because it was not considered as linked to the inexorable mechanisms and laws of nature. It was rather regarded as being organic, as following a natural necessity, a creative process. Free personality and necessity were thereby combined (Dooyeweerd, 1980:74 ff.).

However, the most nihilistic tendencies of the freedom motive in the long run manifested themselves quite clearly. These radical tendencies do not appear yet in the philosophies of Comte or Marx. A goal of history was still maintained there, as well as the idea of progress. But in Nietzsche nihilism tends to become a real threat. In this context Dooyeweerd (1980:81 and 111) also mentions the philosophies of Dilthey, Spengler and Schelling.

The Dooyeweerdian point of view, therefore, is that the gradual loss of confidence in progress can be regarded as a consequence of the fact that the philosophies observed above increasingly relied on the freedom-pole of the humanistic ground motive. This relativistic attitude is regarded by Dooyeweerd as leading to historicism, i.e. the absolutisation of the historical aspect of our experience.[6] The absolutisation of the historical aspect causes a thinker to view all of reality as involved in a constant process of historical change and sight is lost of the constant and stable structures of created reality. The latter are regarded as the merely temporary products of a particular culture in a particular time and context.

6 Basically, we can say that Dooyeweerd uses the term historicism to indicate subjectivism, i.e. as the result of anchoring knowledge/order to the pole of the autonomous personality (i.e. the knowing subject/community). Admittedly, this is a rather unique use of the term. Historicism has a different meaning (e.g.) in Popper. What Popper means by "historicism" is the view that historical prediction is the aim of the social sciences and this aim "is attainable by discovering the 'rhythms' or the 'patterns', the 'laws' or the 'trends" that underlie the evolution of history" (Popper 1961:3; see also 1962:3-8).

As a consequence, for the thinker caught in the historicist way of thinking there are no more constant norms or universal laws. The link between progress and created order is lost.

Historicism has not only been inclined to the "abolition" of universal norms, but has also often *substituted* those universal norms with something more individual or typical. For example, during the Romantic period, the unique *tradition* of a particular nation became the norm according to which the historical development of a certain culture was supposed to be shaped. It is plausible to envisage similar "substitutions" in contemporary philosophy of science as well (see next section).

The consequence of elevating tradition to a norm was a rather conservative attitude which is the opposite of the faith in progress that had nourished movements like the Enlightenment (i.e. linked to the opposite pole of the humanistic ground motive). Under the hegemony of the ideal of freedom, the historical development is not seen as proceeding according to universal laws or according to a rationality hidden within history. The rationalistic tendencies of the Enlightenment are replaced in historicism by irrationalist and relativist tendencies.

5.2 Historicism and progress in recent philosophy of science

The previous analysis provides a framework to understand the late-modern assessment of scientific progress. As contemporary philosophy of science abandoned the positivist views, it gradually came under the influence of the ideal of freedom. This gradually required the abandonment of the optimistic views, so typical of the previous eras. Scientific progress had to be redesigned according to the new demands of the ideal of freedom.

Now scientific progress was gradually made independent from any universal order. As we have seen, according to Kuhn (1970:171-72) for example, progress proceeds knowing its point of departure but deprived of any "ontological development" or simply any "goal". Progress does not bring us closer to any truth, it only creates increasingly useful tools to solve our puzzles.[7] Having lost its link to the truth and to a universal order, the aim of this progress is to satisfy the needs (social, psychological etc.) of the individual (Feyerabend). The happiness of the individual in this case becomes the new subjective "norm", substituting the universal norms that

7 A pragmatist view of progress has been supported especially by Laudan (1978:12 1ff.) who over-estimates, however, the importance of problem-solving in science. In his view problem-solving is virtually the only aim of science while he denies that science searches for any truth.

have been rejected. In other cases the community becomes the true *locus ordinis* [8] for science and therefore for scientific progress as well. In fact, the historicist turn leads to an emphasis on the scientific community.

In the end it is the community, as Botha aptly states, that becomes the "initiator and sanctor of the legitimacy of scientific knowledge and language" (Botha, 1994:21).[9] Progress itself should be sanctioned by the scientific community. But, as the scientific community usually does not reach universal consensus on the recognition of the progress of a particular school or within a particular field, progress tends to disappear from the horizon of many contemporary philosophies of science. Progress becomes mainly an impression, a prejudice of the communities working under the same paradigm, or supporting the same revolutionary change (Kuhn). What remains is the postmodern carnival of a plurality of views, ancient and modern, "achievements" and pretensions, a proliferation of beliefs, views (Feyerabend) and language games (Lyotard).

Postmodern philosophy has taught us that reality is plunged into a historical flux of constant change: changing historical situations, the incessant flux of linguistic meaning and constantly altering social practices. Our culture is impregnated with an image of constant flow excluding anything enduring and persistent. How ironic that in this change there is no room for progress. To admit progress would mean to recognise something that is not simply washed away by the historical flux, something that persists and even grows in this flux. Therefore the idea of progress must be relativised. But the historicist (in the sense of relativist) forgets to relativise the reality of flux and change, and by so doing one achieves the opposite of what one wanted to obtain, namely the destruction of the same concepts of change and history. To use Strauss' words "if everything is history, there is nothing left which can have a history" (Strauss, 2005:225). When change and flux are the only realities it does not make sense to speak of change anymore.

It is not surprising that Popper felt that, due to this drift towards pessimism, the credibility of science itself was threatened, and reacted with the weapons of irony when he said: "for some science is just glorified plumbing" (Popper 1963:102). In the next section we will see how

8 Latin: the foundation of order.

9 In this respect it is interesting to note that after the historical school in philosophy of science (Kuhn *cum suis*) followed a "sociological turn". (See e.g. the title of Brown 1984, *Scientific Rationality: the Sociological Turn*).

reformational philosophy responded to the growing skepticism emerging in humanist circles, concerning the possibility of scientific progress.[10]

6. Reformational philosophy and progress

6.1 Multi-dimensional progress

Stafleu (1987:152) gives us his opinion on the purpose of science: "we consider this aim to be the opening up of the law-side of nature, the discovery and development of law-conformity in reality".[11] In this way Stafleu stresses the normative character of science, as well as the relatedness of science to the created order. In order to deal with the theme of progress Stafleu (1987:152-55) uses a strategy which implies a rather complex elaboration. Firstly he rejects the linear view of progress still maintained by Popper and Lakatos as an inheritance of logical positivism. According to Stafleu (1987:152) "the development of science must not be conceived as a linear process but as a process in several dimensions, in which every direction has its own heuristic". Therefore he proposes his model based on three distinctions which have been introduced by Dooyeweerd.

They can be seen as the three axes of a three-dimensional co-ordinate system. The first distinction (the "upward" z- axis) is that "between laws and anything which is subject to laws" (Stafleu, 1987:53-4). On the one side of this axis we have the law side of nature, on the other we have the subject side. In Stafleu's definition, "subject" indicates whatever is "subject-ed" to a certain law and it refers, therefore, to both the (knowing) subject and the object of knowledge.

This distinction gives rise to philosophical questions concerning the relation between laws and their subjects, about the status of theories, statements and concepts, their meaning and corroboration, about deduction

10 Apart from the authors mentioned in the sections below, others have contributed to the discussion on cultural progress from a reformational point of view. Among them I would like to mention at least Bob Goudzwaard (e.g. 1979, 1984) and Sander Griffioen (e.g. 1986, 1987).

11 A similar definition of the aim of science is provided by Botha (1996:333): "Science is an attempt to describe and explain, with the aid of theories, the regularities and scientific laws that typify phenomena in reality". Both definitions insist on the structural order. Stafleu's definition above is a general one summarising seven more specific aims of the scientific enterprise. Briefly listed, they are: 1) explications of laws, 2) reduction and deduction of laws, 3) abstraction or analysis, 4) reconstruction or synthesis of typical laws, 5) designation of modal aspects and exploration of retrocipations and anticipations, 6) objectification, 7) explanation of individual facts and phenomena (Stafleu, 1980:29).

and induction (Stafleu, 1987:153). The distinction between law and subject, according to Stafleu, also leads to the question concerning the origin of laws. The answer to this question, if explicitly given, shows one's "religious" position. In the Christian view laws (contrary to law statements), are not given or proved by man but have to be discovered in a careful and respectful exploration of the creation (Stafleu, 1987:154).[12]

The second basic distinction is that between universal or general modes of being and structural (typical) ones. This is the y-axis (horizontal). On the one side of it we have the universal and on the opposite side the typical. The third distinction is represented by the x-axis (giving the third dimension to the co-ordinate system). It displays the "series of irreducible modes of experience" (1987:154), the modalities. The model shows that research is not a linear process, but a multidimensional unfolding one.

In addition, the scheme allows to identify four directions of research, besides the processes of induction (directed to the law side) and deduction (directed to the subject side), both linked to the first axis (z) mentioned above. The four directions of research are linked to the other two axes mentioned above, namely y and x. The second axis (y) characterises the distinction between universal and typical laws. They both concern the search for *unity* by the method of analogy, and the search for *structure* by the method of successive approximation. The other two directions of research are related to the z-axis, and they are the search for *objectivity*, by means of mathematisation and the search for *application*, by means of instrumentation" (Stafleu, 1987:154-155).

z-axis (processes of induction and deduction)
Represented schematically: y-axis (search for unity and structure)
x-axis (search for objectivity and application).

Stafleu's analysis continues with a description of the four directions of research, but I don't think it is necessary to follow him in the details of his explanation. My schematic presentation of his model is probably already sufficient to appreciate the depth and differentiation of his theory of scientific progress. In his view "the historical development of science is by no means irrational" (Stafleu, 1987:151). It is on this basis that we are going to explore his view of the "opening-process" in relation to scientific development.

12 In Stafleu's view, there is a specific reformed view of natural laws. The reformed view introduced the idea that truth is conformity to the law (Stafleu, 1987:241). At the same time, this reformational view that the aim of science is "the opening up of the law-side of nature" according to Stafleu has been accepted well beyond reformational circles (Stafleu, 1987:151).

6.2 Progress and creational order

Stafleu's view of the opening process is based on the notion of modal aspects as presented by Dooyeweerd (1984, 2:18-192) and it represents an elaboration of the basic idea of cultural and historical opening process. It is necessary at this point to recollect briefly and clarify the concept of analogical anticipations and retrocipations.

The modal aspects are irreducible to each other, but not isolated from each other. As soon as we reflect on their mutual relationships it becomes clear that (e.g.) the term "historical movement" refers to the historical aspect of reality, but at the same time refers to the aspect of motion, to the kinematic aspect which is earlier in the modal order. This type of analogy is called a "retrocipation" because in the modal scale the kinematic aspect is antecedent to the historical one. In this case the analogy refers back to a "lower" modality and is therefore called retrocipation. On the contrary, when an analogy refers to a successive (or higher) modal sphere/aspect, we have an *anticipation*. In this case the lower modality points towards a higher one. One example in this case is the phrase "artistic feeling". Here we have a phenomenon in the psychic sphere that anticipates the aesthetic modality and points towards it.

According to Stafleu what happens during scientific "revolutions" is by no means the elusive phenomenon described by Kuhn and only vaguely linked to a structural order. What happens is that in the "pre-paradigm phase" scientists are not yet aware of the specific meaning of their concepts. The consensus gained in the phase that Kuhn calls "mature science" is therefore gained through a realisation of the modal meaning of the scientific concepts (Stafleu, 1980:26). The advent of the first paradigm is usually accompanied by the discovery of the retrocipatory analogies of the modal aspects. The subsequent paradigm changes are brought about by the discovery of either a retrocipatory analogy, or (more spectacularly) by the discovery of an anticipatory analogy. Such discoveries are made possible by the increasing degree of abstraction and, at the same time, by the opening up of new typical structures, both in a technical and scientific sense (Stafleu, 1980:26).

The validity of Stafleu's model is supported by many examples from the history of mathematics, geometry and other sciences. The history of mathematics shows that initially the meaning of the concept of number had to be established. Only after that phase the negative and rational numbers were introduced by abstraction. Then the real numbers and vectors were found by anticipation. Examples like these abound in the history of sciences: examples of sudden increases in understanding due to developments in retrocipation, anticipation, abstraction and specification.

Concerning the study of electricity and magnetism, for example, the realisation of the specific meaning of concepts within the specific fields was anticipated by authoritative "summaries" (by Gilbert for magnetism and Du Fay for electricity). This brought about the "isolation" of the specific fields of study, i.e. the realisation of its specific borders and characteristics. Each "summary" consisted of a number of empirical generalisations which were acceptable for adherents of different theories. Such summaries therefore did not constitute the first paradigms gaining the consensus of the community and eliminating rival views. They rather served as starting points for different "schools", in view of the further theoretical and experimental development of the field. For electricity the "opening up" occurred some fifty years after Du Fay's work, with the mathematisation of electricity. For magnetism the opening up had to wait for about 150 years.[13]

6.3 Continuity or revolutions?

This approach may also be fruitful to account for both the revolutions and the continuities between revolutions in the history of science. In other words, the fact that Kuhn saw especially revolutionary changes in that history, while Holton (e.g. 1973) underlined the persistence of certain "themes", is quite understandable from a reformational point of view. In fact, in the opening up of a modal aspect, the latter remains a fundamental and irreducible mode of explanation, though it is seen in a different light.

In the positivist tradition it was assumed that data are largely independent of theories. The accumulation of new data could not produce any change in the meaning of older theories. Meaning invariance was a central tenet in positivism. Of course in the new philosophy of science, Kuhn and Feyerabend, among others, criticised this assumption on historical grounds. In their view all changes of paradigms implied a change in meaning, also with respect to observational facts.

The reformational tradition did not support any kind of meaning invariance. In fact, in the opening process meaning is both deepened and relativised. With the opening up of a modal aspect, the latter is not

13 In this context, Stafleu criticises several aspects of Kuhn's theory of paradigms. He points out for example that what Kuhn considers the first paradigms for electricity and magnetism do not show the typical characteristics that Kuhn attributes to paradigms. In the case of electricity, the acceptance of Franklin's "paradigm" never concluded the previous conflicts about fundamentals. In addition it never obtained the consensus of the rival theories. The same can be said for magnetism. In this case the conflicts about fundamentals started only *after* the "paradigmatic" work of Gilbert (Stafleu, 1979:26).

abolished, it is simply linked through analogies to aspects that may appear before or after it in the modal order. On the one hand, that aspect continues to exist as a fundamental mode of explanation, though it may now be seen in a different light. But the aspect does not remain just the same either. The analogies express the meaning of the aspect, so that both continuity and change take place. This is why the author says that the meaning is both relativised and deepened. A reformational approach goes beyond simple meaning variance or invariance, or the idea that facts are "theory-laden". From this point of view, the fact that both revolutionary developments (Kuhn) and persistent themes (Holton) have been discovered in the history of science, becomes more understandable.

7. Conclusion

The author trusts we have gained insight into the initial question: what causes the increasing skeptical attitude towards the possibility of progress in contemporary philosophy of science? Our theoretical views on progress are supported by a general, pre-scientific view of culture and its purpose. This is in turn influenced by our fundamental commitments, in terms of adherence to a fundamental ground motive. The author trusts this article sheds some light on the links between such pre-scientific commitments and a philosophy of progress. It is also legitimate to conclude that reformational philosophy has some resources to offer in this context. Starting from these resources and elaborating their implications, the reformational community should certainly aim at offering its unique contribution to the broader community of scholars.

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