

Paper Title: Our world is more than physics – A constructive-critical comment on the current science & theology debate

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Abstract:

“Critical realism” is one of the most important positions in the current science and theology debate. An analysis of its origin and meaning leads to the question if this position mostly propagated by physicist-theologians could miss an intrinsic feature of the personal dimension of reality. A deeper meaning of the personal dimension sets human science apart. Taking into account social science’s insight that persons responsible for their conclusions and actions drive the process of science, the moral dimension of science has to be emphasized. To integrate these aspects into a coherent position, a more differentiated epistemological model is needed. The solution proposed in this paper is to modify critical realism to constructive-critical realism. Theologically interpreted, constructive-critical realism remembers humankind’s purpose to shape nature in cooperation with God and with the means of culture toward increasing realization of freedom in relationship. The argument is widely influenced by an analysis of the works of John Polkinghorne.¹

Biography:

1993-2001 Studies of Protestant Theology and Judaism in Bochum, Wuppertal, Jerusalem and Heidelberg

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Paper:

“Almost all scientists believe that they are learning about the actual nature of the physical world that they investigate. Consciously or unconsciously, they are critical realists” claims John Polkinghorne² and leaves us with some questions:

- (1) What does critical realism mean?
- (2) How does Polkinghorne himself interpret critical realism?
- (3) Is critical realism indeed the point of view of a majority of scientists?

In this paper, we can only address the first two of the three questions. The third question, if critical realism is indeed a perspective on science held by a majority of scientists, is impossible to answer without a balanced empirical survey. Of course such renowned

members of the scientific community like Polkinghorne tell us so³. The claim is not a totally new one, though.

(1) It was Ian Barbour who claimed in his *Issues in Science and Religion* that „*scientists usually assume realism* in their work”⁴. It was also Barbour who qualified this scientific realism as a „critical” one. By this, he coined the use of the term „critical realism” in the science and theology debate. In his *Issues*, he presents critical realism as the conclusion of a survey of existing epistemologies and contrasts it with *naïve* realism, which overlooks the role of man’s mind in the creation of theories. Critical realism, Barbour states, acknowledges both: the creativity of man’s mind *and* the existence of patterns in events that are not created in man’s mind. The contribution of the subject is never completely separable from the process of scientific enquiry, although prominence is given to the object⁵.

Drawing on Mary Hesse⁶, Barbour traces the basic idea of the concept back to A.N. Whitehead, whose „critical realism allows for the role of both subject and object in knowledge”⁷. His „social view of reality” included the scientific process. By recognising the abstractive, partial and symbolic character of scientific concepts, Whitehead attempted to do justice to a wide range of human experience – aesthetic, moral, and religious⁸. Equally Barbour aims at a „coherent interpretation of experience” including science and theology⁹, in which critical realism accounts for the similarities between the methods of the two.

(2) Now that we elucidated where the term critical realism stems from and know what it was meant to mean, we want to examine Polkinghorne's use of critical realism more closely. In his fundamental book named *One World*, Polkinghorne defends a view of science, which asserts its achievements to be a „*tightening grasp of an actual reality*”. This is clearly an option for realism. In his explicit interpretation, *critical* realism means, that all that can be achieved in the scientific process will be *verisimilitude*, not truth¹⁰. The term itself and its distinction from naïve realism may stem from Barbour, which Polkinghorne marks as one of the major sources of his own work¹¹.

Special to Polkinghorne’s understanding of critical realism is a certain motto that evolves to describe it: „epistemology models ontology”¹², which means that the totality of what we can know is a reliable guide to what is the case. Polkinghorne links this motto to the understanding of the uncertainty relation. Originally, it was *epistemological* in character; Heisenberg showed there were intrinsic limitations on what could be measured. Yet very shortly, Heisenberg and almost all other physicists were giving the principle an *ontological* interpretation. “It was treated as a principle of actual indeterminacy, not mere ignorance”¹³.

Barbour possibly influences also this train of Polkinghorne’s thought. According to Barbour, it was Heisenberg’s interpretation (endorsed by many physicists) that „*indeterminacy is an objective feature of nature*”, and not only an epistemological limitation of man’s knowledge. Barbour continues: „Such a viewpoint would accord with the critical realism we have advocated”¹⁴. Hence, hallmark of „the real” is not the observable any more, but the *intelligible*¹⁵. In the problematic case of observations in the quantum world, for Polkinghorne this must have been a very insightful thought to adopt. With the slogan

‘epistemology models ontology’, he defends a realist and rational theory of science against constructivist approaches as those of Pickering’s „Constructing Quarks” and Thomas Kuhn’s incommensurability hypothesis¹⁶.

„I believe”, he states, „that nuclear matter is made up of quarks which are not only unseen but which are also invisible in principle.”¹⁷ For Polkinghorne, this apology of the reality of the quantum world is closely linked to an apology of the invisible God. Consequently, he borrows language from theology to describe the strange quantum world: „we know the economic quark but not the immanent quark”¹⁸. Vice versa he proposes the critical realist slogan ‘epistemology models ontology’ to paraphrase Rahner’s Trinitarian rule¹⁹.

Faith seeking understanding

We have seen how much Polkinghorne stresses the parallels between (physical) science and theology. „The scientist and the theologian both work by faith, a realist trust in the rational reliability of our understanding of experience.”²⁰ What inspired him to think so?

Polkinghorne started his theological training with the conviction, that the pursuit of science is an aspect of the *imago dei*²¹. Later, he links this idea to his understanding of critical realism: „the image of God is not so defaced in humanity that we are unable to attain a verisimilitudinous grasp of reality”²². The philosophical ground for this close interlock between science and theology is provided by Polkinghorne’s philosopher of choice: Michael Polanyi. His influence on Polkinghorne we will elucidate now.

„A tacit and passionate contribution of the person knowing what is being known” is a „necessary component of all knowledge”²³, this is the core of Michael Polanyi’s fiduciary programme. The historical source for this insight into the fiduciary ground of the scientific enterprise can be found in St. Augustine’s *nisi credideritis, non intelligitis*²⁴. „A fiduciary philosophy ... (like Christianity) says that we should hold on to what we truly believe, even when realizing the absurdly remote chances of this enterprise, trusting the unfathomable intimations that call upon us to do so”²⁵. According to Polanyi, the unavoidable personal contribution to the process of science shows that it is *man’s calling to responsible commitment, which drives the process of inquiry with universal intent*. It is his philosophy that Polkinghorne adopts when characterizing both science and theology as *fides quaerens intellectum* – faith seeking understanding²⁶.

While in Barbour’s origins the concept of critical realism is affiliated with A.N. Whitehead only, in Polkinghorne’s interpretation Polanyi’s philosophy reveals an increasing influence.

However, the thoughts of Michael Polanyi and A.N. Whitehead converge. As Polanyi builds his philosophy of science on the appreciation of ‘tacit skills of judgements’ – the fact that we know more than we can tell²⁷ –, similarly Whitehead describes a primitive stage of consciousness prior to self-consciousness: a „consciousness of ourselves as arising out of rapport, interconnection and participation in processes reaching beyond ourselves.”²⁸

We will rest a while with Whitehead, because he is more influential on Polkinghorne than –regarding Polkinghorne’s criticism on process philosophy²⁹ – it would seem at first hand. At first, there is Whitehead’s founding influence on the whole concept of critical realism, which Polkinghorne inherits through his reception of Barbour. Of special influence then is Whitehead’s prominent statement on the similarities between „dogmas” of science and religion: „*The dogmas of religion are the attempts to formulate in precise terms the truths disclosed in the religious experience of mankind. In exactly the same way the dogmas of physical science are the attempts to formulate in precise terms the truths disclosed in the sense-perception of mankind.*”³⁰

How can we understand this bold claim? In „Science and the Modern World”, Whitehead shows himself well aware of the apparent conflict thesis regarding science and religion. However, „both religion and science have always been in a state of continual development.”³¹ He argues, that the clash between the two on points of detail should not lead us hastily to abandon doctrines for which there is solid evidence. It is instead a sign, „that there are wider truths and finer perspectives within which a reconciliation of a deeper religion and a more subtle science can be found.”³²

Equally, in his Gifford Lectures Polkinghorne expresses his conviction that a fundamental theory has to be „tough, surprising and exciting” and extends this conviction to theology, too³³. Moreover, the example provided must have appeared congenial to him. Whitehead mentions the two competing theories of light (as particle and as wave) at his time (1926), summarising: „Scientists have to leave it at that, and wait for the future, in the hope of attaining some wider vision which reconciles both”³⁴. It was no other than Polkinghorne’s teacher and colleague, Paul Dirac, who reconciled the two theories by his quantum field theory of light one year later (1927). From here we can understand, what inspired Polkinghorne to compare the way of finding truth in science and religion at the examples of the theory of light and the dual nature of Jesus Christ³⁵.

I conclude. As Whitehead tried „to construct a system of ideas which bring aesthetic, moral and religious interests into relation with those concepts of the world which have their origin in natural science”³⁶, Polkinghorne started his work with the assumption of *One World*. With critical realism as core component of their theories, both Polkinghorne and Barbour are pursuing the aim of a „coherent interpretation of experience”³⁷ or to say it with Polkinghorne’s words: As the possibility of science is the consequence of the deposit of the imago dei within humanity, the unity of knowledge is underwritten by the one true god³⁸. Although Polkinghorne’s interpretation is apparently stronger theological in character, both Barbour and Polkinghorne see the overarching goal of science in the search for *understanding*³⁹. In line with the thoughts of Michael Polanyi, one could hence follow Polkinghorne to characterize the methodological approach of critical realism in both science and religion as *faith seeking understanding*.

I do not want to end this short survey of the roots and aims of critical realism in the science and theology debate without mentioning its third prominent propagator, which is Arthur Peacocke. In his review of „critical realism in science and religion”⁴⁰, he identifies his own term „sceptical and qualified” realism⁴¹ with Barbour’s critical realism. Early he realized the kinship of his thoughts with Barbour’s, especially the kinship of his idea to use a kind of critical realism as a concept to compare science and religion⁴². Although

Peacocke does lay emphasis on the philosophical discussion on realism⁴³, he also feels attracted by the *belief* that sceptical and qualified realism is the working assumption of practical scientists.

Hence, critical realism is indeed, as Polkinghorne claims, „a philosophical position based on the actual experience of the scientific community”⁴⁴. Yet one has to be exact: the community of *natural science*.

Another point of view

Having this observation in mind, I want to ask the question, if the current use of critical realism invoked by scientist- (or to be exact physicist-⁴⁵) theologians as a concept to relate science and theology could not bias the perspective on this relation in natural scientist categories. Could it not lead to an underestimation of the fact that theology is commonly perceived to be part of *humanities*? I do not doubt it to be necessary for „Religion in an Age of Science” to engage with those habits of thought, which prevail in a culture greatly influenced by the success of science⁴⁶. Yet if we regard with which subjects the theological sub-disciplines usually co-operate, it will be more those like literary criticism and history - belonging to humanities. When Polkinghorne remarked, that the contribution of those trained in human sciences in the science and theology debate is too small⁴⁷ this demonstrates at least a growing awareness of the idea that something may have been missed.

What are the origins of this deficit? I suggest to investigate the world views which lead the research. Take the example of Polkinghorne himself: he distinguishes the scientific, the personal and the religious view of the world⁴⁸, because „reality is too rich to be taken in at a single glance; it must be viewed from many perspectives.”⁴⁹ Furthermore, he mentions *science, aesthetics, morality/ethics* and *religion* as windows into the multi-levelled character of the world⁵⁰.

The world view Polkinghorne follows here, is clearly Whitehead’s. His study of *Science and the Modern World* „has been guided by the conviction that the mentality of an epoch springs from the view of the world which is, in fact, dominant in the educated sections of the communities in question. ... The various human interests which suggest cosmologies, and are also influenced by them, are science, aesthetics, ethics, religion.”⁵¹ Polkinghorne somewhat condenses this variety of reality into three realms: the impersonal, the personal and the transpersonal one. „Science and theology lie at the opposite ends of a spectrum of rational human enquiry into reality. At the scientific end is the realm of impersonal experience; at the theological end is the realm of the experience of the transpersonal. In between lie the realms of human personal encounter with reality, which are subjects of disciplines such as aesthetics and ethics.”⁵²

Consequently, as in Whitehead’s metaphysics actually opposed and tried to be reconciled are science (physics and biology) at the one end and religion at the other end of the spectrum. Hence, we may not wonder, that from Barbour to Polkinghorne and all the adherents of the ‘Age of Science’, we find ourselves back in a more or less direct comparison of (physical) science and theology. Although Polkinghorne intended to stress the trustworthiness of just the personal experience⁵³, the position of this very personal realm in his thought is transitional only: it serves to show that there is more in the world than

meets the scientist's eye; it is a step further to acknowledge that „there is a Mind and a Purpose behind the history of the universe and that the One whose veiled presence is intimated in this way is worthy of worship and the ground of hope”⁵⁴. Yet could it not be possible, that there is a major difference built into the personal world, which must not be left out if one wants to compare science and theology adequately?

In any offspring of Barbour's influential approach, „'science' will refer to the natural sciences; except for tangential comments, the social sciences are not explored”⁵⁵. We have to be aware of its consequences: when only natural science is involved, the richness of theology is reduced to a *theology of nature only*. Keeping the existing differences between human and natural sciences in mind, I therefore want to ask the question, if „critical realism” is differentiated enough to serve as an underlying philosophy and concept to relate „science” and „theology”, because its perspective omits social and human sciences. Although this is of course not anyone's intention, I have to ask if we do not face here that sort of „direct epistemological connections between the natural sciences and theology” which according to Philip Clayton „commit a type of category mistake”⁵⁶.

The constructive role of the subject in the process of science

Critical realism accounts for the similarities between the methods of science and religion, but it does *not* take into account the *differences* between the two⁵⁷. The reason for this can be found in the fact, that although Barbour reminds, that „*the contrasts of science and religion must always be kept in mind*”, his emphasis lies on the almost immediately following statement that „*the contrasts are not as absolute as most recent theologians and philosophers have maintained*”⁵⁸. The „*alternative languages*” approach is taken as a mere starting point; „the critical realist cannot remain content with a plurality of unrelated languages” and will „attempt to formulate a coherent interpretation of experience”⁵⁹.

Stressing parallelism and coherence of science and religion, Barbour, and likewise Polkinghorne, realize only a difference in *degree* between the divergent disciplines. When our rational inquiry moves us from physical to personal science, the more deeply the encounter with reality will be, says Polkinghorne; the more cultural factors will play a part, because the dependence on tacit skills of judgement increases⁶⁰. These ideas are Michael Polanyi's, also used by Barbour when pointing out that there is an increasing influence of personality from natural to social to human sciences⁶¹. Yet could it not be, that such a talk of a gradual continuum is unwarranted, because it „neglects a distinctive feature of the human sciences, that continues to separate the study of the human sphere from (even hermeneutically conceived) natural science”⁶²?

It will be helpful to realize that already Michael Polanyi's own treatment of the differences between science, art and religion is more differentiated than how he is presented by Barbour and Polkinghorne. While Polanyi spoke of the *verification* of science by experience, he reserved for the process by which other systems than science are tested the term *validation*⁶³. We realize the different language here? Of course, both are an acknowledgement of a commitment: they claim the presence of something real and external to the speaker. The structure of commitment remains unchanged, but its depth becomes greater;

when we pass from verification to validation, we rely increasingly on *internal* rather than *external* evidence⁶⁴.

What does that mean for a realist position, claiming *the (external) object, not the subject, to make the predominant contribution to knowledge*⁶⁵? It is my hypothesis that a critical realist position is only fitting with natural science. When we pass on to human science or even arts the contribution of the subject cannot be viewed mainly critically any more, but becomes essential to what is going on; in Polanyi's wording, we rely increasingly on "internal evidence". As the structure of commitment and the universal intent remains, I believe we can rest with realism to express this intention, but I would prefer to label the realism „constructive” realism then. Realism at its core is a *personal belief and a commitment* to an external reality.

What could sound as a paradox, for me expresses quite well the intention of *Personal Knowledge*. Contrary to that, the integration of Michael Polanyi's concept of tacit knowing which „cannot be critical”⁶⁶ into „critical” realism cannot present a too lucky choice. Polanyi makes clear, that the role of the subject *cannot* be portrayed as a minor element in the process of inquiry. It is the subject's *passionate contribution and commitment to universal intent*, which only allows to speak of not only subjective, but „personal” knowledge⁶⁷. Yet aware of the basic similarities between Polanyi's thought and that of Whitehead it does not make sense to me to abandon the concept of critical realism totally. However, I want to emphasize Polanyi's insight, that the role of the subject presents a magnificent constructive task, and that's why I want to leave a tribute to this in my very epistemology, calling it „constructive-critical realism”.

Double Hermeneutics

In my view, Polkinghorne is quite right to remark that 'the scientist and the theologian both work by faith, a realist trust in the rational reliability of our understanding of experience.' I only think, he is failing to fully connect this to an insight of Thomas F. Torrance: „It is always the nature of things that must prescribe for us the specific mode of rationality that we must adopt toward them and prescribe also the form of verification apposite to them”⁶⁸. I conclude from here, that the *rationalities of natural, social, human science and of course theology are different ones*, and I go on with Polanyi to say that the verification taking place in human science and art would better be called *validation*.

Utilized to overcome the alternative language approach, critical realism ignores these differences. To avoid this invalid shortcut and to find a way to keep the differences between the realms of reality, I suggest it to be helpful to go back to the early mechanist times of science. There, it has been necessary to sharply distinguish the personal from the impersonal realm to save the subject in personal science. I believe, therefore history can tell us best, where the epistemological differences between the two realms reside – the differences, which critical realism tends to forget.

It has been Wilhelm Dilthey, who coined the term „Geisteswissenschaften” (humanities) just against those that tried to subjugate every science under a mechanistically shaped natural scientific methodology⁶⁹. His argument for a distinction of the realm of humanities is that while in natural sciences, nature is the focus and explanations have to try to

extinguish the human factor as much as possible, focus of the human sciences is the *totality* of life including meaning, value and purpose. Here, one can only understand by going through a vivid experience (*Erlebnis*) that constitutes nature *for oneself*⁷⁰. While in natural science, the method is to *recognize* physical objects, in human science *understanding* of the object of research is needed beforehand. We have to remember this distinction between *explaining and understanding*. The emphasis on originality in human sciences (in contrast to the search for general laws in natural sciences) is its consequence only⁷¹. In Clayton's words, social scientists do not only have to regard their own subjectivity, they also need empathically to *understand* their objects of study as a necessary *precondition* for exploration and explanation⁷²; in addition to the interpretative framework imposed by every researcher, the *object* of research here is itself symbolically structured⁷³.

Polanyi objected any sharp dichotomy between science and humanities like Dilthey's, but only because he wanted to emphasize the personal character of *all* knowledge, including natural science⁷⁴. Nevertheless, he remained aware of differences between the disciplines. "As the subject of our understanding ascends to higher levels of existence, it reveals ever new comprehensive features, the study of which requires ever new powers of understanding."⁷⁵

By the application of the double adjective „constructive-critical” on realism, I therefore want to remember Dilthey's historical insight on differences between impersonal and personal science. For the science of the impersonal, a mostly critical view of the personal involvement in the process of science may justifiably dominate, because according to intersubjective agreement and commitment, the object of study is the impersonal world. But in the science of the personal, the degree of personal involvement is so deep to call it simply a „critical” element. Already the „subjective” character of the object of enquiry demands a higher estimation of the subject in the process of knowledge. Hence the sciences of the personal cannot simply claim objective reality to major on the subjective element within the process of science, as plain critical realism does. When science becomes an interpersonal inquiry, the process of knowledge is recursive in a higher degree. „When we reach the point at which one man knows another man, the knower so fully dwells in that which he knows, that we can no longer place the two on different logical levels.” Observation becomes encounter⁷⁶. Verification turns to validation.

As I have mentioned, this distinction of methodologies according to the different objects researched, is an idea much stressed by Thomas F. Torrance⁷⁷. Polkinghorne is well aware of this idea, and even labels the insight that *components of reality ... are known in ways that accord with their natures* and that we cannot determine beforehand what these epistemological modes will be as „congenial to the scientific mind”⁷⁸. We remember that ‘epistemology models ontology’. Nevertheless I believe it remains necessary to modify critical realism, if we want to take into our epistemological account the different quality of the personal realm as a result of biocultural evolution. Polkinghorne's awareness of the differences resides on an ontological level only, there he demands “a radical revision of any metaphysical scheme that sought to allot ontological priority simply to those aspects of reality that are accessible to the enquiry of natural sciences.”⁷⁹ Yet if epistemology models ontology, should the variety of reality not also lead to a more flexible and diversified epistemology?

I want to summarise. I have argued that the degree of subjective involvement especially in personal science is too strong to remain calling it just „critical”. I add to that my own emphasis, that especially in the human sciences, it is not only a source of uncertainty; the personal element *structures* the social reality under „observation”. It is Dilthey’s insight, worked out by Polanyi’s philosophy of personal knowledge that paved the way for a better perception of the constructive element in the process of science as activity of persons. My conclusion for incorporating the meaning of the *personal sciences* within the theory of science then is to propose a modification to critical realism called „constructive-critical realism”. As stressed by Torrance but also recognized by Polanyi, differences between the different domains exist, and the double adjective „constructive-critical” recalls that each object has to be known in its own way. Hence we should at least differentiate personal and impersonal „objects” in their relation to the personal factor. The „critical” view of the personal element as a self-critical enterprise with universal intent may dominate in the process of the natural sciences; the „constructive” view of the personal element may major in the process of human science – not to mention other domains of culture, such as arts and religion. In the impersonal realm, full understanding is the final goal of the search for rational explanations; in the personal realm emphatic understanding is a necessary precondition without any explanations can be found at all.

I see no difficulties to remain with realism, because in what we learned to be Polanyi’s contribution to Polkinghorne’s understanding of critical realism, we find answer to post-modernist doubt. The realist’s „desk-thumping, foot-stamping shout of ‘really!’”⁸⁰ is not meaningless, but does make deep sense, because without this ever daring leap of faith, no knowledge nor understanding could ever be achieved. It is indeed totally sufficient for science to select the coherent system of statements with the greatest possible comprehensiveness and „*treating it as true*”⁸¹. Yet by submitting to one’s own sense of responsibility a valid choice *can* be made, since this act is called forth by the agent’s utmost submission to his intimations of reality⁸².

Our access to truth is limited; each person can know directly very little of truth and must trust others for the rest⁸³. Nevertheless, this limited access to truth represents the ground on which we can claim freedom and respect. It provides the spiritual foundation of a free society, the achievement of which Polanyi called „man’s cosmic calling.”⁸⁴

Our constructive-critical challenge

The concept of constructive-critical realism assumes that in the process of science (and in its application as well), *cultural construction carrying ethical decisions* is taking place. In the last part of this paper I want to deal with the ethical and theological assumptions incorporated in the concept.

Biblically spoken, culture can be portrayed as an essential element of *creation*; man’s making of the tent of the covenant mirrors God’s making of the world (cf. Gen 1 with Ex 24ss)⁸⁵. By the means of culture human being takes part in the world’s continuous creation. The well-known concept of Philip Hefner to view man as „created co-creator” spells this out⁸⁶. It „refers to the emergence of a creature, *Homo sapiens*, (1) who on the one hand is thoroughly a creature of nature and its processes of evolution – hence the term created – and (2) who at the same time is created by those very processes as a creature of

freedom.” *Freedom* is meant here to describe the condition of existence in which humans unavoidably face the necessity both of making choices that govern their behaviour and of constructing stories that contextualise and hence justify their choices: creating culture⁸⁷.

The created co-creator concept joins the attempts to overcome dualistic understandings of human beings that insist – unaware of its ecological consequences – on separating us from nature and its evolutionary processes in which we have emerged. Instead, the understanding of biocultural evolution will lead us to face the challenge to construct a cultural system that interfaces with our world as meticulously and as adequately as our physiobiogenetic systems do⁸⁸. Theologically interpreted, as *God’s* created co-creator it is man’s purpose to enable the systems of nature so that they can participate in God’s purposes in the mode of freedom⁸⁹. As images of God, humans are created to be an explicit representation and presence of God’s will in creation. God gave us an example to follow: the paradigm of the created co-creator is Jesus Christ.

I want to adopt Hefner’s concept because it beautifully illustrates the task of human kind and the means and the meaning of the creative processes, which take place in cultural construction. Yet it is my opinion, that in Hefner’s concept an account of the *ambiguity* of nature is missing; we do not only have to be aware of nature’s „marvellous fecundity and ingenious strategies for living”, but of „its wastefulness and suffering” as well⁹⁰. With Polkinghorne, also these ambiguities have theologically to be interpreted. Perhaps one can recognize a „cruciform pattern of life through death” and view it as a necessary cost of a creation that was given by its Creator the freedom to be itself⁹¹. Yet there are some who recognise no more than the strife of selfish genes struggling for survival (Richard Dawkins) or blind chance at work (Jacques Monod).

This should lead us to recall, that Biblically spoken humankind is not able of creation (*bara* is reserved for God’s work), but only of „making” (*asa*). Although not intended – especially not by Peacocke who stressed the *co-creation* when coining the term⁹² – the latter language could indeed carry with it the danger of the root sin of hubris, ‘to be like God’ (Gen 3). Hence, Polkinghorne prefers the more modest language of stewardship (tillers of God’s garden, cf. Gen 2) to that of co-creators⁹³. Although this term may sound paternalistic, I do not agree that it has to carry a dualistic notion that separates humans from the rest of nature⁹⁴. In my opinion, there *is* a categorical distinction between humanity and nature, because only human kind is created in the image of God. The error is not to make this distinction, but somewhat to forget *who* made it: God, not humankind. To present the image of God is not a reward but a free gift that calls for responsible answer.

In constructive-critical realism, the critical element remains and may be a helpful reminder in the questions under discussion. Man is not only constructing, he is also destroying the world, that is why we *have* the ecological debate. Additionally, one has to be aware of the fact that the cooperation of humankind in continuous creation is limited, because man *cannot reproduce nature*⁹⁵. That makes a difference. Humankind cannot create nature, but only culture – in shaping nature. In theological language one could therefore translate the „constructive-critical” challenge of man, remembering the Biblical differentiation between *bara* and *asa*, to be „*created for co-operation*”.

The moral dimension

Constructive-critical realism stresses the scientific enterprise to have a *constructive* direction to shape the world by the use of culture toward the realisation of increasing freedom - yet *critically* aware of its limits: nature's limited resources and sin's diminishment of man's ability of recognition. The knowledge of humankind is essentially different from God's wisdom, because the particular perspective of humankind can never overlook the whole of the world⁹⁶. I guess, that is why the „fear of the Lord is the beginning of knowledge” (Prov 1:7) respectively wisdom (Ps 111:10).

Hefner acknowledges existing „incompetence in constructing adequately the cultural systems”⁹⁷, yet I think this is not only a consequence of man's detachment of nature, but moreover, his detachment of God, Biblically called sin. It is a very worthwhile enterprise to explore science and technology to be better informed in the responsible task of co-creation - this is of course a huge merit of the science and theology debate⁹⁸. Yet I believe, as long as humankind is not in harmony with creation (hence, since the fall), the danger of our kind trying to ‘play God’ *remains*. As a true co-creator I could only envision humankind in its primordial or eschatological nature. Instead, human beings can *co-operate* in creation, when they are aware of their own creator, which incorporates awareness of being bound to nature. *Adam* (man) is made from *adama* (earth), inspired by God's breath of life (Gen 2:7).

Constructive-critical realism recalls the ethical standards for adequately constructing cultural systems. In science, charity of reference is needed, viz. constructive-critical feedback, which has to orientate itself at the *fruitfulness* of the research program. Yet fruitfulness does not mean pragmatic productivity. It is an ethical task to distinguish the *quality* of the fruits, and to judge on the goodness of our fruits we need a purpose that counts⁹⁹. According to constructive-critical realism this is *humankind's purpose to shape nature in cooperation with God and with the means of culture toward increasing realization of freedom in relationship*.

Beyond our limits

My final question in this essay is where theology could be situated within what I sketched to be my idea of „constructive-critical realism”. First of all, as the Creator of all reality is prior to all human knowledge, I see *realism* as quite the right point to start for theology, too. It recalls the limits of our creativity and productivity; we *cannot* create a new nature, and we depend on God. Now, although I have won some significant insight from remembering theology as usually situated in the human sciences (the German expression *Geisteswissenschaften*, „science of mind”, renders this more intuitive to understand), I do not want to leave theology there. Instead I think it is indeed the reward of the science and theology debate to show that theology belongs neither to natural science nor to human science. Instead, the science of the transpersonal has to incorporate the impersonal *and* the personal realm¹⁰⁰.

To „re-search” God, one therefore needs to regard *both* elements presented, the constructive and the critical one. Where it comes to knowledge, one has *critically* to recall God's transcendence and sin separating as from God. We have to discern our own projections of

God (resulting from our wish to be like God) from his self-revelation. This is where Feuerbach is right. Yet where it comes to deeds, we are asked to *constructively* cooperate with God according to his revealed will, making his immanence present all through the world. The truth of God has to be proofed by our lives. His will of love has to be lived. The divine values have to be validated by us.

When the Gifford Lectures require the lecturers to engage in ‘Promoting, Advancing, Teaching and Diffusing the study of Natural Theology’ and to ‘treat their subject as a strictly natural science’, I surely believe this to be a worthwhile enterprise. I also think, there *is* a kind of parallelism existing between the process of knowledge in impersonal and transpersonal science. Yet this parallelism is a culturally mediated, second-order one. The role of models and metaphors has to be elucidated before one could answer how exactly natural science and theology interrelate. Theology has to draw not only on the impersonal, but also on the personal sciences. This also means, that the moral dimension of science remains crucial for theology. „There is an inevitable moral component to the religious life”¹⁰¹, visualised in the paradigm Jesus Christ.

Concluding consequences

Our language reveals how we view the world. Critical realism is aware of the subject’s role in the process of science, but this role is presented in spectator-language. Hence I perceive the term „world-view” to be misleading, because it ideally presupposes the position of a detached observer of the world. This supposition stands against our insight, that we are *part* of the whole of the world, always involved in the processes under observation. I think it would be in line with Michael Polanyi to argue that as *it is us* who drives the process of science, every worldview chosen includes an ethical decision, a „research programme” so to say¹⁰². If we stop speaking of „world-views” and start speaking of „research programmes” instead, we make clear that the observer becomes an actor on the stage of inquiry and has to face the ethical question: what to do?

We must not continue to perform science pragmatically simply for the sake of productivity. We must not force our cultural diversity into the paradigm of a natural-scientific scheme where ever increasing economy and rationality cease to present value and beauty and start to endanger the values of the personal realm. It is a reward of the current science and theology debate and its emphasis on the similarities between science and theology to remember us of the one world as creation of the one God. Yet the insight of Dilthey must not be lost, which points to intrinsic differences in the personal realm. Only when we properly regard these aspects within our approach, we can adequately remember the responsibility of science as a personal enterprise.

With the idea of constructive-critical realism I want to enforce the consciousness of diversity on an epistemological level, realizing that if we extend epistemology to human sciences, the recognition of its ethical implications cannot be avoided. I believe, that a more differentiated concept like this is needed for the science and theology debate to develop into a really interdisciplinary discussion. Our world is more than physics. It is even more than meta-physics. It is God’s vivid creation, allowed to be itself in its *multitude* of dimensions. „Human experience is diverse and varied, and each field of inquiry must

have its own autonomy; any limited synthesis will have to allow for considerable pluralism.”¹⁰³

¹ I have to express my gratitude to Christian Link, John Polkinghorne and Robert John Russell for commenting on an initial draft of this paper. I also have to thank ESSSAT for the opportunity to present my ideas in a workshop on the Barcelona conference 2004. In any case, the sole responsibility for the argumentation remains with me.

I am also grateful to Theology and Science to allow the online publication of this article before its appearance in print in its October issue 2005.

² John Polkinghorne, „Metaphysics of Divine Action”, in: Robert John Russell, Nancey Murphy, Arthur Peacocke (eds.), *Chaos and Complexity. Scientific Perspectives on Divine Action* (Vatican Observatory Publications/CTNS, 1995), 148.

³ Additionally, an ad hoc survey of interested readers of the Journal „Physics World” (April 2002) on the question at issue indeed led to the result that many (and perhaps even most) respondents could well accept the basic tenets of a Polkinghorne-style critical realism.

⁴ Ian Barbour, *Issues in Science and Religion* (SCM Press, 1968), 171.

⁵ Ibid.

⁶ Mary Hesse, *Science and the Human Imagination* (SCM Press, 1954).

⁷ Barbour, *Issues*, 206.

⁸ Ibid., 130s.

⁹ Ibid., 269.

¹⁰ John Polkinghorne, *One World* (SPCK, 1986), 22.

¹¹ Ibid., 99.

¹² John Polkinghorne, *Science and Christian Belief* (SPCK, 1994), 156. The formulation is meant to summarize John Polkinghorne, *Rochester Roundabout* (Longman, 1989), ch.21.

¹³ Polkinghorne, „Metaphysics of Divine Action”, 148.

¹⁴ Barbour, *Issues*, 303.

¹⁵ Ibid., 170.173.

¹⁶ Polkinghorne, *Rochester Roundabout*, ch.21.

¹⁷ John Polkinghorne, *Belief in God in an Age of Science* (Yale University Press, 1998), 122.

¹⁸ Ibid.

¹⁹ John Polkinghorne, *Science and Theology* (SPCK, 1998), 114.

²⁰ Polkinghorne, *Belief in God*, 124.

²¹ John Polkinghorne, *The Particle Play* (Freeman, 1979), 126.

²² John Polkinghorne, *Reason and Reality* (Trinity, 1991), 6.

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- ²³ Michael Polanyi, *Personal Knowledge*, (Routledge, 1998 [First publication of corrected edition: 1962]), 312.
- ²⁴ *Ibid.*, 266s.
- ²⁵ *Ibid.*, 318.
- ²⁶ Polkinghorne, *One World*, 28. Michael Polanyi, *Science, Faith and Society* (The University of Chicago Press, 1964), 45.
- ²⁷ Michael Polanyi, *The Tacit Dimension* (Doubleday & Company, 1983), 4.
- ²⁸ Alfred North Whitehead, *Symbolism* (Cambridge University Press, 1928), 65. It is from this quote, that Barbour concludes his emphasis on realism: „Our primitive awareness is of being in a world, not of constructing one”. (Barbour, *Issues*, 171).
- ²⁹ Polkinghorne, *Science and Christian Belief*, 22s.
- ³⁰ Alfred North Whitehead, *Religion in the Making* (Meridian, 1960 [First publication: 1926]), 57. Quoted in Barbour, *Issues*, 129.208 and in Polkinghorne, *One World*, 28.
- ³¹ Alfred North Whitehead, *Science and the Modern World* (Penguin, 1938 [First publication: 1926]), 211.
- ³² *Ibid.*, 214.
- ³³ Polkinghorne, *Science and Christian Belief*, 1.
- ³⁴ Whitehead, *Science and the Modern World*, 214.
- ³⁵ Polkinghorne, *Belief in God*, ch.2.
- ³⁶ Alfred North Whitehead, *Process and Reality* (Macmillan Free Press, 1969 [First publication: 1929]), vi.
- ³⁷ Barbour, *Issues*, 269.
- ³⁸ Polkinghorne, *Belief in God*, 122.
- ³⁹ Barbour, *Issues*, 172s; John Polkinghorne, *Science and Creation* (SPCK, 1988), xi.
- ⁴⁰ Arthur Peacocke, *Intimations of reality. Critical realism in science and religion* (University of Notre Dame Press, 1984).
- ⁴¹ Arthur Peacocke, *Creation and the World of Science* (Clarendon, 1979), 21s.
- ⁴² *Ibid.*, 22, ann. 38.
- ⁴³ *Ibid.*, 22, ann. 37.
- ⁴⁴ Polkinghorne, *Science and Theology*, 17.
- ⁴⁵ Even Peacocke is a *physical* biochemist (Polkinghorne, *Belief in God*, 78).
- ⁴⁶ Polkinghorne, *Science and Christian Belief*, 1.
- ⁴⁷ Polkinghorne, *Belief in God*, 78.80.
- ⁴⁸ John Polkinghorne, *The Way the World is* (Triangle/SPCK, 1983), headlines of ch. 2-4.

- ⁴⁹ John Polkinghorne, *Faith seeking understanding* (Yale University Press, 2000), 13.
- ⁵⁰ *Ibid.*, 14.27.
- ⁵¹ Whitehead, *Science and the Modern World*, 7.
- ⁵² Polkinghorne, *Science and Theology*, 128.
- ⁵³ Polkinghorne, *The Way the World is*, 17ss.
- ⁵⁴ Polkinghorne, *Belief in God*, 1.
- ⁵⁵ Barbour, *Issues*, 9.
- ⁵⁶ Philip Clayton, *Explanations from Physics to Theology. An Essay in Rationality and Religion* (Yale University Press, 1989), vii.
- ⁵⁷ Cf. Barbour, *Issues*, 267.
- ⁵⁸ *Ibid.*, 268.
- ⁵⁹ *Ibid.*, 268s.
- ⁶⁰ Polkinghorne, *Reason and Reality*, 9.
- ⁶¹ Barbour, *Issues*, 203.
- ⁶² Clayton, *Explanations*, 88.
- ⁶³ Polanyi, *Personal Knowledge*, 202.
- ⁶⁴ *Ibid.*, 321.
- ⁶⁵ Barbour, *Issues*, 169.
- ⁶⁶ Polanyi, *Personal Knowledge*, 264.
- ⁶⁷ *Ibid.*, 300.
- ⁶⁸ Thomas F. Torrance, *Theological Science* (Oxford University Press, 1969), 12.
- ⁶⁹ Wilhelm Dilthey, *Gesammelte Schriften Bd. 1* (Teubner Leipzig/Berlin, 1922), 11.
- ⁷⁰ Wilhelm Dilthey, *Gesammelte Schriften Bd. 7* (Teubner Leipzig/Berlin, 1927), 83.
- ⁷¹ *Ibid.*, 86s.
- ⁷² Clayton, *Explanations*, 100s.
- ⁷³ *Ibid.*, 88.
- ⁷⁴ Polanyi, *The Tacit Dimension*, 16s. Michael Polanyi, *The Study of Man* (The University of Chicago Press, 1959), 101s.
- ⁷⁵ Polanyi, *The Study of Man*, 73.
- ⁷⁶ *Ibid.*, 94.

- ⁷⁷ Torrance, *Theological Science*, 9s.
- ⁷⁸ Polkinghorne, *Belief in God*, 81. The quantum world does not follow Aristotle's logic, for instance.
- ⁷⁹ John Polkinghorne, „Evolution and Information: The Context”, *Currents in Theology and Mission* 28:3-4 (June/August 2001), 251.
- ⁸⁰ Arthur Fine, „The Natural Ontological Attitude”, in: Jarrett Leplin (ed.), *Scientific Realism* (University of California Press, 1984), 97.
- ⁸¹ Clayton, *Explanations*, 178.
- ⁸² Polanyi, *The Study of Man*, 62s.
- ⁸³ *Ibid.*, 68.
- ⁸⁴ *Ibid.*, 97.
- ⁸⁵ Michael Welker has remembered this insight of Benno Jacob (Michael Welker, „Creation: Big Bang or the Work of Seven Days?”, *Theology Today* (July 1995), 173-187.
- ⁸⁶ Philip Hefner, „Biocultural Evolution and the Created Co-Creator”, in: T. Peters (ed.), *Science and Theology. The New Consonance* (Westview, 1998), 174-188.
- ⁸⁷ *Ibid.*, 175.
- ⁸⁸ *Ibid.*, 176.
- ⁸⁹ *Ibid.*
- ⁹⁰ Polkinghorne, *Belief in God*, 11.
- ⁹¹ *Ibid.*, 13s.
- ⁹² Peacocke, *Creation and the World of Science*, 304ss.
- ⁹³ John Polkinghorne, *Beyond Science* (Cambridge, Canto edition 1998), 115.
- ⁹⁴ Hefner, „Biocultural Evolution and the Created Co-Creator”, 186.
- ⁹⁵ Johannes von Lüpke, *Anvertraute Schöpfung. Biblisch-theologische Gedanken zum Thema „Bewahrung der Schöpfung“* (Lutherisches Verlagshaus Hannover, 1992), 51.
- ⁹⁶ *Ibid.*, 68.
- ⁹⁷ Hefner, „Biocultural Evolution and the Created Co-Creator”, 176.
- ⁹⁸ Arthur Peacocke, *Theology for a Scientific Age* (Fortress, 1993), 343.
- ⁹⁹ Murphy, Nancy 1998. „Theology, Cosmology, and Ethics”, in: Ted Peters (Ed.), *Science and Theology. The New Consonance*, Westview, 108.
- ¹⁰⁰ Already Günter Howe (Günter Howe, „Parallelen zwischen der Theologie Karl Barths und der heutigen Physik“, in *ibid.*, *Die Christenheit im Atomzeitalter* (Ernst Klett Verlag Stuttgart, 1970), 81) remarked, that in the conflict between natural and human science, generally spoken theologians found themselves back naïvely taking sides with human science. Theologians did not take into account, in so far as apologetic

needs did not urge them to deal with this question, that with „man in cosmos” they lost a topic crucial for the physicist.

¹⁰¹ Polkinghorne, *Science and Theology*, 129.

¹⁰² For now, I do not want this term to be understood as a reference to Imre Lakatos.

¹⁰³ Barbour, *Issues*, 264.