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*Plenary Agenda Report for Research Group D-II-1*

### The Ontology of Space

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Keywords: Ontology •  
Space • Knowledge • Body  
• Extension • Boundaries •  
Impenetrability • Continu-  
ity • Motion • Potentiality  
• Colocation • Place •  
Skepticism

**Abstract:** *(a) Topics and Objectives.* Research Group D-II-1 investigates the metaphysics of space – in contrast to D-II-2, which focuses on the role of space in physical theory. The group’s work gives special emphasis to knowledge of space and its relationship to knowledge of the physical world generally. A central concern has been the relationship between space and bodies. One question concerns the way in which bodies (on some views) exclude one another from the regions of space they occupy. Is this phenomenon grounded in the physical, causally relevant properties of physical bodies, or rather in the metaphysical relationship between bodies and their locations or spatial extension? Plato’s *Timaeus*, with its pioneering and immensely influential theory of geometric elementary bodies, provides a particularly interesting test case for this question. An additional objective is to clarify Aristotle’s understanding of the metaphysics of bodies. There are numerous passages in Aristotle which contain remarks on the topic, but there are also numerous puzzles and difficulties about how to interpret those passages in a satisfying and coherent way. Moreover, a clearer understanding the metaphysics of bodies will enable a new understanding of various topics within Aristotle’s metaphysics. Especially important is the way the unity of sensible substances is related to their topological connectedness. Our third goal is to clarify the relationship between ancient geometrical and physical conceptions of body and of bodily limits by focusing on Sextus Empiricus’ parallel treatments in *Against the Physicists* and *Against the Geometers*. Alongside these topics concerning space and body, the group is researching the relationship in Aristotle between change, potentiality, and place. Our goal is to clarify the relationship between the ontological status of places and the ontological status of change. This involves a reconsideration of Aristotle’s definition of change and his classification of changes.

*(b) Methods.* The group applies interdisciplinary methods – in particular ones drawn from philosophy, classical philology, and the history of science – to a variety of texts. The group engages in the reconstruction and critical interpretation of rational philosophical arguments. But such reconstructions are not the exclusive province of philosophers, and require expertise from classics about language, texts, and contexts, as well as expertise from the history of science about contemporary science, the development of particular scientific concepts, and the historiography of scientific concepts (e.g., how to think about the continuity and discontinuity of the concept of »space« across radically different cultural and intellectual contexts).

*(c) Status of Discussion.* The group’s work has led to a highly productive focus, in several projects, on the relationship between space and body. This development has resulted from and led to further exchanges within the group, and connects much of the group’s work with a wider trend in ancient philosophy which deals with ancient concepts of body.

Projects:

- »Aristotle’s Metaphysics of Bodies« (Christian Pfeiffer; ; dissertation project)
- »Change and Potentiality in Aristotle’s Natural Science and Metaphysics« (Andreas Anagnostopoulos)
- »Space, Body, and Extension« (Gábor Betegh)
- »Body as Substance versus Body as Quantity« (Gábor Betegh, Christian Pfeiffer, Francesca Pedriali [D-III-E-II-2 *Mapping Body and Soul*])

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## 1 Results

This group's main achievement has been to bring into focus a cluster of issues concerning the relationship of space and body. This relationship is intimately connected with the status of knowledge of space and its relationship to knowledge of body. These issues surface in a variety of diverse but related philosophical contexts from the pre-Socratics, through Plato and Aristotle, to the Hellenistic schools and the commentary literature of Late Antiquity.

Bodies are three-dimensionally extended. But is being three-dimensionally extended sufficient for being a body? Or are other properties – such as impenetrability – also necessary? Can there be three-dimensionally extended entities that are neither bodies nor properties of bodies? Can two bodies be in the same place at the same time or overlap? If not, what is it about bodies that precludes this? In virtue of what are bodies causally efficacious? Merely in virtue of being three-dimensionally extended? Or in virtue of further properties?

These issues arise, for instance, in Plato's *Timaeus*, where Plato describes the divine craftsman as fashioning particles of earth, air, fire, and water. These particles are geometric solids (regular cubes, icosahedra, tetrahedra, and octahedra, respectively). It becomes clear that, when these bodies converge they collide (rather than passing through one another). But the scientific narrative contained in the text does not tell us why this should be so. Are these bodies impenetrable? And if so, then why?

Gábor Betegh has worked out an answer to this question on Plato's behalf, one that does not rely on notions of impenetrability. This makes his answer both philosophically interesting (since one would have expected impenetrability to play a role) and textually justifiable (since the text says nothing about impenetrability). Betegh's answer involves two parts. The first concerns any two bodies of different kinds, for instance a particle of fire one of water. Any two bodies of different kinds will necessarily have opposite properties that supervene on their geometrical properties (for instance hot and cold), and opposite properties cannot be present at the same time at the same place. Thus such bodies, with different geometrical and hence physical properties, cannot interpenetrate due to the mutual exclusion of opposites. This account does not, however, apply to two bodies of the same kind (two particles of fire do not have opposite physical properties), and a second answer must be sought to cover such cases. The proposed, and more tentative, answer relies on the stricture, explicit in the text, that these crafted bodies be as beautiful as possible – where »beautiful« means »geometrically regular.« If two particles of the same kind were to interpenetrate, a terribly misshapen body would result – or at least a body that is not beautiful.

The *Timaeus*, then, accounts for the fact that bodies collide and do not interpenetrate in a completely different way than we might have expected. This fact derives from general metaphysical facts about opposites and from teleological facts about beauty.

Our working group has arrived at three results regarding Aristotelian themes related to body and to space. The first concerns the reasons why Aristotle espouses the doctrine that two bodies cannot be in the same place at the same time. Aristotle clearly asserts this doctrine in a number of places in his works. (It is denied just as clearly by the Stoics.) But he does not explain its basis. Christian Pfeiffer has worked out a very interesting idea,

which, like Betegh's reading of the *Timaeus*, explains this principle about bodies in much more »metaphysical« terms than one might have expected. In particular, Pfeiffer thinks that Aristotle specifies necessary and sufficient conditions for the individuation of bodies in terms of their boundaries. Two bodies cannot be in the same place because this would entail that they have the same boundaries at the same time, which is for Aristotle impossible. Pfeiffer explains in detail how this view is entailed by texts about bodies and their boundaries and works out thoroughly the philosophical picture that emerges.

He has also recognized a problem that is created by Aristotle's views about body, substance, and continuity. In particular, Aristotle believes that perceptible substances are living organisms which necessarily have complex (non-homogenous) bodies. But Aristotle also thinks that substances are continuous and that no two bodies can be continuous with one another. Two bodies might touch at their extremities, but continuity is something else. In particular, continuity comes about when the extremities of »two« bodies become one. In such cases, it follows that there is only a single body. It is not clear how this view about continuity is compatible with the complex (non-homogenous) character of substances. For this would seem to entail that substances have internal boundaries between the various non-homogenous parts – for instance, a boundary between a bone and some surrounding tissue, or between blood and flesh. But Aristotle seems to think that such boundaries would entail that there are not one but two bodies. The discovery and development of this problem itself qualifies as a »result« in the sense that it is an intellectually valuable outcome of our research.

Moreover, Pfeiffer proposes a solution, one that he is now working out in detail. The nub of the solution is that Aristotle requires us to rethink our pre-theoretical intuitions about the locations of the boundaries of bodies. While we might have thought that the question of where there are boundaries is »merely« mathematical or physical, it turns out to be an essentially metaphysical question for Aristotle, one whose answer depends on which bodies we take to be substances. This set of issues places Pfeiffer in a position to make a major contribution to Aristotle scholarship, partly by illuminating the largely ignored concept of body in Aristotle, and partly by providing a new approach to well-worn issues about substance and unity.

Our group has also addressed another problem which has been largely ignored until now, which related to the metaphysical status of bodies in Aristotle. The problem concerns the classification of bodies vis à vis the categories. Aristotle recognizes distinct categories of beings, including substances and quantities. Categories are mutually exclusive: whatever belongs to one category cannot belong to another. This is especially important for the category of substance, since the substances are the entities that all other entities depend on. Any quantity depends on a substance, whereas a substance is that on which quantities (etc.) depend. For this reason, it is perplexing that Aristotle clearly and emphatically categorizes bodies both as substances and as quantities. Gábor Betegh and Christian Pfeiffer, together with Francesca Pedriali (a member of D-III-E-II-2 *Mapping Body and Soul*), have written a paper explaining this problem and proposing a solution. The solution requires distinguishing two senses of body. In one sense, body is defined as three-dimensionally extended figure (where being a figure requires having definite boundaries and hence a determinate shape and size). Bodies in this sense belong to the category of quantity, that is, they are not substances but rather quantitative aspects of substances. In the other sense, body is instead defined as the bearer of certain (active and passive) causal

powers, such as a living animal. These bodies are substances, not quantities. Bodies in the second sense necessarily have bodies in the first sense, but they are not identical with them, and thus the two kinds of bodies can belong in distinct categories.

The group is also working on the ontology of space in Aristotle through the lens of change and potentiality. This provides a complementary approach to our work on space and body. It is also intimately connected with Groups D-II-2 (*Place, Space, and Motion*) and D-III-E-II-2 (*Mapping Body and Soul*), and there have been extensive exchanges among the members of these groups. For instance, there was an intensive reading group on *De Anima* involving several members of both groups during winter semester 2009/10. (In the future, some reorganization will help to clarify thematic affinities among projects.)

Anagnostopoulos has been attempting to clarify what change, including in particular locomotion, amounts to for Aristotle. Both the metaphysical status of change and the metaphysical presuppositions of Aristotle's conception of change remain hotly contested issues. Anagnostopoulos argues that several of Aristotle's most fundamental discussions of change in his *Physics* are motivated not by convictions about the ontology of change, but by the need for change to be subject to explanation. This is of absolute importance, since for Aristotle, changing things are the primary object of natural science. Anagnostopoulos's bold view is that Aristotle's conception of change does not commit him to the problematic claim that change is an »actuality« (*entelecheia*). This is a term Aristotle employs, and probably invented, to capture the ontological status of entities that are most real and most complete instantiations of a kind. Change, for Aristotle, is understood as a sub-species of the more general category of process or activity. This raises several difficult questions about how to distinguish genuine changes from other activities. Aristotle is well aware of the importance of spelling out the boundaries of the concept of change. For this will (partly) determine the scope of his natural science, which is the study of the world insofar as it is subject to change.

One of the most interesting such cases concerns the boundary between natural science and psychology. Aristotle famously characterizes perception as »an alteration of a sort.« Although he employs the basic framework of natural science in his account of perception in *De Anima*, Aristotle is careful to point out that this framework does not apply in any straightforward way to the case of perception. Anagnostopoulos argues that the crucial factor that distinguishes perception from genuine change can be traced back to Aristotle's definition of change in *Physics* III, as »the activity of a potential being, as such.« According to Anagnostopoulos, Aristotle has in mind a restricted notion of potentiality that applies to the subjects of change, but not to perceivers, as such. Anagnostopoulos's collaboration with the group, »Mapping Body and Soul« (D-III-E-II-2) has been especially fruitful in supporting his research on the relations between Aristotle's natural science and psychology.

Perhaps the most important metaphysical presupposition of change stems from the idea that change, for Aristotle, is an expression of an object's potentiality. Anagnostopoulos has submitted for review a paper that is devoted to identifying and distinguishing the senses of *dunamis* (power, potentiality) employed by Aristotle. The dependence of change on potentiality also raises special difficulties for the ontology of place. Aristotle's account of change, of which locomotion is a species, commits him to the idea that locomotion is the activity of an object that is potentially somewhere, in other words, of an object with a »potential place.« This, however, appears to conflict with Aristotle's explicit account of

place and void in book IV of his *Physics*. The notion of place required by Aristotle's account of locomotion seems to be a notion of place as something capable of being filled by different bodies, logically separable from any particular body. On the other hand, *Physics IV* puts forward as fundamental the notion of the place of a particular thing and rejects as tantamount to a version of the void the idea of place that is logically independent of body, but includes some obscure remarks to the effect that void might exist »as potential.«

Anagnostopoulos is also working on the relation between space, change, and time, with the aim of understanding their common topological properties, for example, the fact that all three are continuous but only finitely divisible in actuality. Aristotle's systematic commitments appear to give priority to space over spatial change, and priority to change over time, insofar as Aristotle defines time as a »number of change.« This suggests that the topological features of time are to be understood as following from the topological features of space, via the notion of change.

Body returns to center stage in Betegh's work on Sextus Empiricus. In *Against the Physicists*, Sextus argues against the coherence of the very concept of body. He rightly contends that most of the dogmatic philosophers of nature are corporealists, i.e. take body as their ultimate principle. But if they cannot provide us with a coherent conception of body – and Sextus aims to show that they cannot – their whole dogmatic theoretical edifice crumbles. Oddly, however, Sextus's arguments are drawn, often word for word, from another work, *Against the Mathematicians*. This is curious and problematic because most of the targeted dogmatic schools, most notably the Epicureans and the Stoics, did not accept that physical bodies could be described as derivable from mathematical bodies, and thus that the mathematical conception of body, and the notions of geometrical limit entities, would be applicable to physical bodies and their boundaries.

Betegh draws two related conclusions. First, he suggests that Sextus may in fact have borrowed from earlier physicists' arguments against the geometrical concept of body. But while the physicists used these arguments either to show the internal incoherence of geometry or to show its irrelevance to a description of physical bodies, Sextus turns these arguments against the physicists themselves. Is this reasonable and justified, or is it sophistry? This brings us to Betegh's second conclusion. Sextus seems to work on the reasonable (although certainly defeasible) assumption that the coherence of any physical concept of body presupposes the coherence of the geometrical concept of body. After all, all the relevant parties agree that both physical bodies and geometrical bodies are three-dimensionally extended figures. It is thus reasonable to think that if the concept of a three-dimensionally extended figure is incoherent, then *a fortiori* the concept of physical body, like the concept of geometrical body, is incoherent.

In the earlier phases of the project, Christof Rapp also organized a conference on »The Place of Ideas« (focusing on Aristotle's criticisms of the Platonic theory of forms in *Metaphysics A 9*), and a workshop on Epicurus's *Letter to Herodotus*. These were very productive events at which group members came together with leading scholars from abroad. Since Rapp has departed, they no longer represent ongoing projects within the group.

## 2 Publications

Anagnostopoulos, Andreas. 2010. »Change in Aristotle's *Physics* III«. *Oxford Studies in Ancient Philosophy* 40, 33–79.

Anagnostopoulos, Andreas. Forthcoming. »Aristotle's Parmenidean Dilemma«.

Anagnostopoulos, Andreas. Forthcoming. »Senses of *Dunamis* and the Structure of Aristotle's *Metaphysics* Θ.

Beere, Jonathan. 2008. »The Priority in Being of *Energeia*«. In Michel Crubellier – Annick Jaulin – David Lefebvre – Pierre-Marie Morel (eds.), *Dunamis: Autour de la puissance chez Aristote*. Leuven: Peeters Publishers. 429–56.

Beere, Jonathan. 2009. *Doing & Being: An Interpretation of Aristotle's Metaphysics IX*. Oxford University Press.

Beere, Jonathan. 2010. »Metaphysics«. In Michael Gargarin (ed.), *The Encyclopedia of Greece and Rome*. Oxford: University Press.

Beere, Jonathan. Forthcoming. »Akt und Potenz«. In Christof Rapp – Klaus Corcilius (eds.), *Aristoteles-Handbuch*. Stuttgart: Metzler.

Beere, Jonathan. Forthcoming. »Form und Materie«. In Christof Rapp – Klaus Corcilius (eds.), *Aristoteles-Handbuch*. Stuttgart: Metzler.

Betegh, Gábor. 2010. »What Makes a Myth Eikos?«. In Richard D. Mohr (ed.), with Kirk Sanders and Barbara M. Sattler, *One Book, the Whole Universe: Plato's Timaeus Today*. Las Vegas, Nev.: Parmenides Publishing. 213–26.

Betegh, Gábor. Forthcoming. »Paul Tannery and the *Pour l'histoire de la science hellène. De Thalès à Empedocle (1887)*«. In O. Primavesi (ed.), *Presocratic Studies in Europe from the Later Middle Ages to Hermann Diels*. Stuttgart: Steiner.

Betegh, Gábor. Forthcoming. »Sextus on Body in *Against the Physicists* (M 9.359–440)«. In Keimpe Algra – Katharina Ierodiakonou (eds.), *Sextus Empirius: Against the Physicists*. Cambridge: University Press.

Betegh, Gábor. Forthcoming. »The Next Principle. Aristotle, *Metaphysics* A3–4«. In Carlos Steel (ed.), *Aristotle, Metaphysics A*. Oxford: University Press.

Betegh, Gábor. Forthcoming. »The Transmission of Ancient Wisdom«. In Lloyd Gerson (ed.), *The Cambridge History of Philosophy in Late Antiquity*. Cambridge: University Press. 25–39.

Betegh, Gábor – Pedriali, Francesca – Pfeiffer, Christian. Forthcoming. »Aristotle's Concept of Body in *De Caelo* 1.1.« *Rhizai. A Journal for Ancient Philosophy and Science*.

### 3 Talks and Presentations

Beere, Jonathan. »Thinking Thinking Thinking: Aristotle's *Metaphysics*  $\Lambda$  9«. Classical Philosophy Conference, 6.–7. December 2008, Princeton University. Also delivered at the Sorbonne, Paris; Oxford University; the University of California, Los Angeles, and the University of Chicago.

Beere, Jonathan. »Wahrnehmung bei Aristoteles: Etwas, das man tut, oder etwas, das einem passiert?«, Ludwig-Maximilians-Universität München.

Betegh, Gábor.»The Causal Efficacy of Bodies in Plato's *Timaeus*«, Charles University Prague.

Betegh, Gábor – Pedriali, Francesca – Pfeiffer, Christian. »Aristotle's *De Caelo* 1.1«. SEEAP Workshop on Aristotle *De Caelo* 1, University of Zadar.

Pfeiffer, Christian. »Aristotle – On Continuity and Contact«, University of Zagreb.

Pfeiffer, Christian. »Aristotle on the Priority of Bodies«. Graduate Colloquium in Ancient Philosophy, Humboldt-Universität zu Berlin.

Pfeiffer, Christian. »Aristotle on *Physics* V, 3«. Graduate Colloquium in Ancient Philosophy, Humboldt-Universität zu Berlin.

Pfeiffer, Christian. »Aristotle on Being in the Same Place«. Colloquium »Recent Work in Ancient Philosophy«, Humboldt-Universität zu Berlin.

### 4 Events

Workshop: »Epicurus' Letter to Herodotus«. Contributions by Attila Nemeth, Gábor Betegh, Karel Thein, Máté Eros, Christian Pfeiffer, Francesca Masi, Jakub Jirsa, Péter Lautner, Ana Gavran Milos, Filip Grgic, Luka Borsic. Berlin, May 16–17, 2008.

Workshop: »Body, Quantity, and Substance«. Organized by Gábor Betegh and Christian Pfeiffer. Berlin, July 15, 2010.

Conference: »The Place of Ideas – Aristotle's *Metaphysics* A 9. Contributions by Dorothea Frede, Michel Crubellier, Christof Rapp, Jacob Rosen, Tim Clarke, Gail Fine, Pieter Sjoerd Hasper, Tim Wagner. Berlin, January 9–10, 2009.

## 5 Further Grants

In their capacities as Codirectors of the Graduate School for Ancient Philosophy, Jonathan Beere and Christoph Helmig, have received a three-year, € 300.000 grant from the DAAD to support a binational network for doctoral study. The grant will finance collaboration with Princeton, Toronto, Chicago, and Leuven intended to foster cooperative advising of graduate students in ancient philosophy at these institutions.

## 6 Citation

Jonathan Beere – Gábor Betegh – Christian Pfeiffer, »Plenary Agenda Report for Research Group D-II-1 ›The Ontology of Space«.« In Friederike Fless – Gerd Graßhoff – Michael Meyer (eds.), *Reports of the Research Groups at the Topoi Plenary Session 2010*. eTopoi. Journal for Ancient Studies, Special Volume 1 (2011). <http://journal.topoi.org>.