Module 3, opdracht 3. Proefschriftsamenvatting

**Aanvullende instructie:**

Vertaal één van de volgende teksten.

**ThinkingSkins**

*Cyber-physical systems as foundation for intelligent adaptive facades*

Under the guiding concept of a thinking skin, the research project examines the transferability of cyber-physical systems to the application field of façades. It thereby opens up potential increases in the performance of automated and adaptive façade systems and provides a conceptual framework for further research and development of intelligent building envelopes in the current age of digital transformation.

The project is characterized by the influence of digital architectural design methods and the associated computational processing of information in the design process. The possible establishment of relationships and dependencies in an architecture understood as a system, in particular, are the starting point for the conducted investigation. With the available automation technologies, the possibility of movable building constructions, and existing computer-based control systems, the technical preconditions for the realisation of complex and active buildings exist today. Against this background, dynamic and responsive constructions that allow adaptations in the operation of the building are a current topic in architecture. In the application field of the building envelope, the need for such designs is evident, particularly with regards to the concrete field of adaptive façades. In its mediating role, the façade is confronted with the dynamic influences of the external microclimate of a building and the changing comfort demands of the indoor climate. The objective in the application of adaptive façades is to increase building efficiency by balancing dynamic influencing factors and requirements. Façade features are diverse and with the increasing integration of building services, both the scope of fulfilled façade functions and the complexity of today's façades increase. One challenge is the coordination of adaptive functions to ensure effective reactions of the façade as a complete system. The ThinkingSkins research project identifies cyber-physical systems as a possible solution to this challenge. This involves the close interaction of physical systems with their digital control. Important features are the decentralized organization of individual system constituents and their cooperation via an exchange of information. Developments in recent decades, such as the miniaturisation of computer technology and the availability of the Internet, have established the technical basis required for these developments. Cyber-physical systems are already employed in many fields of application. Examples are decentralized energy supply, or transportation systems with autonomous vehicles. The influence is particularly evident in the transformation of the industrial sector to Industry 4.0, where formerly mechatronic production plants are networked into intelligent technical systems with the aim of achieving higher and more flexible productivity.

In the ThinkingSkins research project it is assumed that the implementation of cyber-physical systems based on the role model of cooperating production plants in Industry 4.0 can contribute to an increase in the performance of façades. Accordingly, the research work investigates a possible transfer of cyber-physical systems to the application field of building envelopes along the research question:

**How can cyber-physical systems be applied to façades, in order to enable coordinated adaptations of networked individual façade functions?**

To answer this question, four partial studies are carried out, which build upon each other. The first study is based on a literature review, in which the understanding and the state-of-the-art development of intelligent façade systems is examined in comparison to the exemplary field of application of cyber-physical systems in the manufacturing industry. In the following partial study, a second literature search identifies façade functions that can be considered as components of a cyber-physical façade due to their adaptive feasibility and their effect on the façade performance. For the evaluation of the adaptive capabilities, characteristics of their automated and adaptive implementation are assigned to the identified façade functions. The resulting superposition matrix serves as an organizational tool for the third investigation of the actual conditions in construction practice. In a multiple case study, realized façade projects in Germany are examined with regard to their degree of automation and adaptivity. The investigation includes interviews with experts involved in the projects as well as field studies on site. Finally, an experimental examination of the technical feasibility of cyber-physical façade systems is carried out through the development of a prototype. In the sense of an internet of façade functions, the automated adaptive façade functions ventilation, sun protection as well as heating and cooling are implemented in decentrally organized modules. They are connected to a digital twin and can exchange data with each other via a communication protocol.

The research work shows that the application field of façades has not yet been exploited for the implementation of cyber-physical systems. With the automation technologies used in building practice, however, many technical preconditions for the development of cyber-physical façade systems already exist. Many features of such a system are successfully implemented in the prototype development. The research project therefore comes to the conclusion that the application of cyber-physical systems to the façade is possible and offers a promising potential for the effective use of automation technologies. Due to the lack of artificial intelligence and machine learning strategies, the project does not achieve the goal of developing a façade in the sense of a true "ThinkingSkin" as the title indicates. A milestone is achieved by the close integration of the physical façade system with a decentralized and integrated control system. In this sense, the researched cyber-physical implementation of façades represents a conceptual framework for the realization of corresponding systems in building practice, and a pioneer for further research of ThinkingSkins.

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**Stoic philosophy and the exegesis of myth**

In this dissertation, I set out to analyse the philosophical foundations of the Stoic involvement with mythical material and aspects of religion. In part one I laid out the Stoic theory of preconceptions as well as Stoic ideas about the origin of misconceptions and the development of humanity as the groundwork for the school’s practice of dealing with mythical material, which I subsequently discussed in the second part. In this conclusion I will review the main findings and indicate the wider implication of these results.

The Stoic interpretation of aspects of Greco-Roman myths was a fruitful enterprise in which the school, for all its variations and different emphases, displayed a remarkable continuity from Zeno and Chryssipus to Cornutus and Dio Chrysostomos. The Stoics not only claimed consistency for their philosophy, but also held that it was in agreement with the non-philosophical tradition of myth, of which they remained critical nonetheless. This was made possible by their conceptions of the status of preconceptions as both veridical and inarticulate notions and their concomitant double-sided evaluation of myth as containing primeval insights that were eminently natural, but at the same time primitive and partial, cognitions.

The philosophical doctrines behind the Stoic exegetical practice were the subject of the first part of the present study. In chapter 1, I argued that according to the Stoics preconceptions are notions that are formed naturally on the basis of impressions and that gradually come into being along with the development of reason in rational beings in the first years of their lives. This origin of preconceptions guarantees their self-evident truth, which is required for their most important function as criteria of truth. However, this is not to say that with preconceptions we also have true knowledge (*epistêmê*).

In chapter 3 I traced two answers to the question of how exactly the Stoics thought the natural and spontaneous creation of true conceptions is likely to derail into the mistaken views of the man in the street. These answers amount to what we may call the epistemological side of the stoic explanation of moral evil: the persuasiveness of the things themselves and corruptive talk by the people around us. The newborn child, who is supposed to be all natural and pure, is easily convinced by the things themselves. I pointed out that the infant, lacking a preconception of the good, tends to confuse pleasure *per se* and pleasure as a side effect of the good in his very first postnatal experiences and thus that it is likely that he ends up with a misconception of pleasure as the good instead. The second reason for the development of misconception is perhaps even more important for the issues raised in the present study. The talk of the people around us encompasses what is expressed in traditional media, such as poetry and sculpture. In effect, children do not grow up and develop their preconceptions in an ideal situation that is free from corruptive influences, but in an environment that is already deeply infected by errors. This draws our attention to the situation for the first people, who, having no instructors, at least escaped this particular problem. I maintained that in a very relevant sense the first generation of mankind is comparable to newborn babies: primeval people were innocent because they lacked vice and are unspoiled, not because they were virtuous and philosophically sophisticated. Or, to put it epistemically, the insights of the earliest people are valuable because they were uncorrupted, but this value is qualified by the observation that they did not have knowledge, but only partial cognition that was easily supplanted by misconceptions.

In both sets of philosophical doctrines discussed in chapter 1 and 3 the Stoics reacted to philosophical views of other schools. The theory of preconceptions had its origin in Epicurus and many philosophers had presented views on the condition of mankind at the beginning of civilization. On both issues, the Stoics proposed subtly nuanced views. Their critics in antiquity, such as Plutarch, Philodemus, and Diogenianus, often found Stoic doctrine disagreeable and austere, if not downright absurd. However, they tended to disregard the nuances, distinctions, and qualifications of the Stoic position in their polemics and used these distortions to turn the tables on the school. Despite the unfortunate predicament of the historian of (early) Stoicism with respect to the sources, the polemical tactics of these opponents are still visible. In chapter 2, for instance, I drew attention to a notable and fundamental misconception that we find in both ancient and current debates in which the Stoic theory of preconceptions is misunderstood as a theory of universal consensus. This misunderstanding is due to the mix-up and polemical distortion of subtly different original terminology. I argued that while ‘natural notion’ is a synonym for ‘preconception’, ‘common notion’ is not. It is easy for an uncharitable author such as Plutarch to substitute ‘notions’ for ‘preconceptions’ while ignoring the special status and causal origin of the latter. Similar tactics of weakening the contrast between natural and acquired notions can also be detected in Diogenianus’ argument against Chryssipus’ *On Fate*. Such strategies facilitated the development of fully-fledged arguments from *consensus omnium*.

The two faces of preconceptions, as fundamentally true but inarticulate notions, and the similarly double-sided characterization of humanity at the beginning of its history, as untainted but primitive, determine the Stoic perspective on, and interpretation of, traditional religion and myth.

*Bron: Van Sijl C. (2010). Stoic philosophy and the exegesis of myth. PhD thesis, Universiteit Utrecht.*

**Marine biogeography and evolution**

*Diversity patterns of planktonic gastropods and amphipods*

Current changes in the oceans, including global warming and ocean acidification, are partially caused by human activity, unlike earlier episodes of change throughout geological history. Understanding and forecasting the responses of marine organisms to these changes is top priority for scientists, managers and policy makers. Yet, relatively little is known of the effects of ocean change on marine zooplankton. Ocean change affects species diversity and distributions, but different zooplankton taxa may not be equally affected. This thesis aims to fill this knowledge gap by contributing information regarding taxonomy, genetic diversity, and biogeography of several selected marine zooplankton groups, providing baseline information that is needed to track the effects of ocean change on marine zooplankton. The study organisms in this thesis represent two groups of planktonic gastropods: pteropods (sea butterflies and sea angels) and heteropods (sea elephants), and a group of crustaceans: the hyperiid amphipods. Pteropods are uniquely suitable for the study of long-term evolutionary processes in the open ocean because their aragonite shells provide a good fossil record. They have been proposed as bioindicators to monitor the impacts of ocean acidification. Heteropods are another group of pelagic gastropods that independently colonized the pelagic. They are visual predators that prey upon shelled pteropods. Shelled heteropods have received little attention relative to pteropods, but are probably equally vulnerable to the effects of ocean acidification. Hyperiids represent a highly diverse and abundant group and are often commensals and parasitoids of gelatinous plankton. They play unique and important ecological roles in pelagic foodwebs.

The major questions that are being addressed in this thesis are:

1. How can closely related pteropod species be distinguished?
2. When did current pteropod biodiversity evolve?
3. Which pteropod, heteropod, and hyperiid amphipod species are where in the Atlantic Ocean?

**How can closely related pteropod species be distinguished?**

To be used as bioindicators of ocean acidification, it is important to accurately assess species boundaries of pteropods, because different species are expected to respond differently to ocean changes. An integrative taxonomic approach based on combining morphological, genetic, and geographic information was applied to assess species boundaries in the circumglobal pteropod genera *Cuvierina* and *Diacavolinia* (chapters 3, 4, and 5). The approach combined molecular phylogenetic analyses based on Cytochrome Oxidase I (COI) and 28S DNA sequences, geometric morphometric analyses of shells, as well as ecological niche modelling (only in Chapter 3). Museum samples provided an essential initial framework for assessing species boundaries based on morphological information and a substantial source of information for increasing geographic coverage.

Based on geometric morphometric analyses, six morphotypes were distinguished within the genus *Cuvierina* (Chapter 3). These morphotypes had distinct ecological preferences and belonged to three major genetic clades. Using a fossil-calibrated phylogenetic analysis, it was estimated that these clades separated in the Late Oligocene and Early to Middle Miocene. Based on these findings, two previously distinguished subgenera of *Cuvierina* were rejected and a new species endemic to the Pacific Ocean was described (Chapter 4). Current consensus is that there exist two Atlantic, two Pacific and two Indo-Pacific *Cuvierina* species. These species can generally be distinguished based on their differences in shell shape and size, but more information is preferred to more confidently confirm their status as species. Because not all taxa were distinguished based on COI sequences, the number of genetic markers should be increased.

*Diacavolinia* is the most speciose genus of shelled pteropods with 24 described taxa. The measurements of several hundreds of freshly-collected and museum specimens including type specimens provided evidence for a reduction in the number of species to a maximum of 13 species (Chapter 5). The most important biogeographic barriers were between the Atlantic and Indo-Pacific oceans, and between the East and Central Pacific. These barriers are well-known for other zooplankton groups as well.

All in all, an integrative approach proved successful in distinguishing between pteropod species, although additional molecular markers are needed to more accurately distinguish between closely related taxa, as was demonstrated for *Cuvierina* and *Diacavolinia*. Moreover, some rare *Diacavolinia* taxa currently lack morphological and/or genetic information. Hence, additional sampling efforts are still needed, especially in the highly diverse Indo-Australian Archipelago and the East Pacific Ocean.

**When did current pteropod biodiversity evolve?**

Combined with molecular methods for phylogenetic inference, the fossil record improves our understanding of the evolution of pteropods by providing a framework of ages for certain shelled taxa. The phylogenetic relationships of 55 pteropod species (euthecosomes, pseudothecosomes, and gymnosomes) collected from all ocean basins and spanning the diversity of the group were inferred using time-calibrated molecular phylogenies based on combined analyses of cOI, 28S, and 18S gene sequence data and information of the fossil record (Chapter 2). However, the phylogenetic relationships between (sub)orders euthecosomes, pseudothecosomes, and gymnosomes were not resolved based on the available information. The uncoiled euthecosomes were monophyletic, and within this group, *Creseis* was monoplyletic, as well as all other uncoiled genera together. Most uncoiled genera were also supported, but *Clio* was polyphyletic, and *Diacavolinia* grouped within *Cavolinia*, rendering the latter genus paraphyletic. The coiled euthecosomes were not monophyletic contrary to the accepted morphology-based taxonomy, but individual genera were. With the first occurrence of coiled euthecosomes estimated at 79–66 million years ago (mya), it was inferred that uncoiled euthecosomes evolved 51–42 mya and that most extant uncoiled genera originated 40-15 mya, with *Creseis* as the earliest diverging lineage at 41–38 mya. These findings are congruent with a molecular clock analysis using the Isthmus of Panama formation as an independent calibration. Although not all phylogenetic relationships could be resolved, the new data on the diversity and evolution of pteropods are an essential first step for their use as bio-indicators of the ongoing effects of ocean acidification. To improve phylogenetic resolution, especially at higher (order or suborder) levels, it will be necessary to increase the number of genetic markers substantially (e.g., by applying a phylogenomic approach). For future studies, it is also necessary to increase taxon sampling of pseudothecosome and gymnosome taxa, which were underrepresented in this study.

*Bron: Burridge A.K. (2017). Biodiversity and evolution of planktonic gastropods and amphipods. PhD thesis, Universiteit van Amsterdam.*