illustrating sampling locations of specimens. MorphDBase also entails a literature data base for referencing purposes. Furthermore, every entry in MorphDBase can be commented upon.We work on further developing MorphDBase to become a mediating tool between data representation and phylogenetic inference, closing the methodological gap between data production and tree evaluation. MorphDBase is online (http://www.morphdbase.de) since 25 September 2006. This study was supported by the Deutsche Forschungsgemeinschaft DFG (VO 1244/3-2).

MorphOntology: A Slution to the Linguistic Problem of Morphology

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In biology, we deal with an overwhelming multiplicity of different kinds of objects, ranging from molecules and nucleotide sequences to morphological structures, whole organisms, and entire ecosystems. A pragmatic way to deal with this diversity is the application of the comparative method, which therefore takes a central role in biological research. Morphology represents an important phenotypic data source. However, it has major problems concerning its representation and scientific value with respect to transparency and reproducibility of data production and, thus, with its comparability. Morphology suffers from what we call the Linguistic Problem of Morphology: lack of both a standardized terminology and a standardized and formalized method of description. Here, we will focus on standardizing morphological terminology. On the basis of the Resource Description Framework (RDF), we will suggest a morphological ontology, that is, MorphOntology, which is conceived to provide a formalized glossary for morphological data, in which terms are defined and their interrelationships specified. We will also provide an example of how a morphological structure of an invertebrate can be described with MorphOntology. The combination of MorphOntology with a morphological database will provide a regional solution to the terminology problem. Within a database, MorphOntology will provide a shared vocabulary for morphologists to communicate their result efficiently. MorphOntology enables the application of description logics, which allows powerful and less ambiguous data querying, the use of computers for data exploration, inference and mining. This study was supported by the Deutsche Forschungsgemeinschaft DFG (VO 1244/3-2 & BA 1520/9-2).

On Historical Natural Kinds

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How can we qualitatively distinguish the class of (a) objects with a name beginning with “A” from (b) objects that I believe are red, (c) objects that are toxic, (d) human individuals that possess the disposition to completely metabolize alcohol, or (e) all human beings or all copies of a single issue of a daily newspaper? What do all these classes have in common? Why may some objects belong to several types of classes at the same time and why does this not cause inconsistency? To give an explanation to all these questions, I will start from a general definition of “class” and point out conceptual differences between artificial, typological, and natural classes. I will show that it is necessary to define “naturalness” with respect to causality—elements of a natural class are defined by identity of their causal relations. As a consequence, all natural classes possess explanatory power. I discuss two possible types of natural classes: essentialist natural kinds, which represent “universal cause” classes that are defined in reference to causal dispositional properties, and historical natural kinds, which represent “historical cause” classes that are defined in reference to a common historical origin from a particular sequence of causal processes. Furthermore, I will discuss the concept of homeostatic property cluster kind and its role within biological research. Finally, I will discuss the uniqueness of phylogenetic systematics as a natural classification of historical natural kinds whose unambiguous encaptic hierarchical order is the result of its historical nature.

General Subjects IX—Contributed Papers

Origin and Organization of the Trophosome in a *Sclerolinum* Symbiosis (Annelida)

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The small genus *Sclerolinum* belongs to the unique monophyletic polychaete family Siboglinidae that consists of four taxa, the Vestimentifera, Frenulata, *Sclerolinum*, and *Osedax*. All representatives develop a symbiont-housing organ, the trophosome, and loose a functioning digestive system during their ontogenesis. The vestimentiferan trophosome—a complex lobate organ with an apolar tissue of bacteriocytes—develops from the visceral mesoderm between the dorsal blood vessel and the gut. In *Sclerolinum*, the sister taxon to Vestimentifera, the trophosme is described as a simple two layered cylinder. The inner layer—a solid core of bacteriocytes—is thought to originate from the endodermal midgut. We reinvestigated the origin and ultrastructure of this symbiont-bearing organ in juvenile and adult specimens of a recently discovered *Sclerolinum* species from the Gulf of Mexico. In juveniles, it was restricted to a few bacteriocytes located between the gut and the dorsal blood vessel. In adults, it was much larger invading the whole body cavity, cylindrical in shape, penetrated by intercellular blood spaces. The entire trophosome tissue including the surrounding epithelium was composed of bacteriocytes containing polymorphic endosymbiotic bacteria. Density of symbionts and number of sulfur vesicles in bacteria varied a lot. The ventrally located gut lacked symbionts at all stages and consisted of a ciliated endothel surrounded by myoepithelial peritoneal cells in juveniles, but was reduced to some ciliated cells in adults. Consequently, the trophosomes of the two sister taxa *Sclerolinum* and vestimentiferans can bee seen as a homologous structure having evolved from the visceral mesoderm.

Cement Ultrastructure and Adhesive Glands Morphology in the Tube-Dwelling Polychaete *Sabellaria alveolata*

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Sabellaria alveolata, a gregarious polychaete common along European coasts, is a compulsive builder. It collects inert particles in its surroundings and glues them together with spots of cement to form a rigid tube. In SEM, the cement appears to be made up of hollow spheroids from 0.3 to 3 μm in diameter embedded in a matrix. This ultrastructure gives the cement a porous aspect when fractured. TEM observations demonstrated that the spheroid cortex consists of electron-dense fibrillar material disposed in concentric layers. In addition to the spheroids, the matrix encloses electron-dense granules and lacunae measuring 50–700 and 50–2500 nm in diameter, respectively. The cement is produced by large unicellular glands which are situated in the anterior part of the animal, in the parathoracic region, and which open at the level of a specialized building organ made up of two lobes located near the mouth. These cement glands are of two types: those containing homogeneous granules and those containing heterogeneous granules. Both types of granules range from 2.5 to 4 μm in diameter and enclose a moderately electron-dense homogeneous material. In heterogeneous granules, very electron-dense fibrillar inclusions are embedded in this homogeneous material. Comparison between the ultrastructure of the granules and that of the cement clearly indicates that the homogeneous material from both types of granules forms the cement matrix while the hollow spheroids derive directly from the inclusions of the heterogeneous granules, which inflate through a still unexplained process. Immuno-gold labeling of both cement and glands confirms this model.

Structural and Molecular Characterization of Chaetal Formation in Annelids

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Chitinous chaetae, which arise from epidermal follicles, are one of the most characteristic features of annelids. Generally, the follicle consists of different cell types, which contribute to the formation process of the chaetae. Of these, the basal chaetoblast controls the structure of the growing chaeta by basal apposition of beta-chitin on the surface of highly dynamic microvilli, whereas the lateral follicle cells seem to secrete additional chaetal components. Structures similar to annelid chaetae are known from Echiura, Myzostomida, and Pogonophora (which by now are supposed to be subordinated taxa of Annelida), but also from Brachipoda and certain members of Mollusca and Bryozoa. Homology of these structures with annelid chaetae is debatable. To better resolve their evolution, we have therefore started to complement structural comparisons with a molecular characterization of the cell types involved in chaetogenesis in the annelid *Platynereis dumerilii*. Combin-