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the question arises as to whether or not there were potentially new life modes available for opportunistic microbes. The answer is yes, and in particular it appears that calcium carbonate exoskeletons of bryozoans, if not other invertebrates, provided substrate opportunities. Other invertebrates with similar exoskeletons could serve as alternative substrates. The advantages are increasing surface areas for incrusting and providing a variety of substrates above the sediment-water interface. Our preliminary studies show that the bryozoan exoskeleton support a garden of microflora that includes filaments, diatoms, coccoliths, bacilli and cocci morphotypes, and extensive deposits of biofilm. The microbes fossilize in a similar manner to those found on the surfaces of rocks and other sediments. The fossilized forms indicate the presence of the following ions: Ca, Mg, Fe, Al, with lesser levels of K and P. Microbial roles have changed, and as the Earth evolves, opportunistic microbes will adapt.

POSSIBILITIES AND LIMITATIONS OF THREE DIMENSIONAL RETRODEFORMATION OF A TRILOBITE AND PLESIOSAUR VERTEBRAE

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Three-dimensional fossils have often been deformed during preservation. Such deformation usually causes pronounced asymmetry, which could bias the outcome of morphometric studies. It is therefore desirable to remove the distortions by a geological deformation model. This process, called retrodeformation, has been practiced two-dimensionally by previous workers. We explored the possibilities of expanding the model to three dimensions. We used one individual of the trilobite *Phacops rana* and 11 cervical vertebrae of the elasmosaurid plesiosaur *Thalassomedon haningtoni* for our study. All specimens apparently had simple distortion, i.e., homogeneous compression and/or expansion that can be modeled by a linear transformation. We collected coordinate data from the laterally

symmetrical pairs of landmarks to calculate the three-by-three symmetric matrix that represents the linear strains. Assumptions were made that: (1) the original animal was bilaterally symmetrical on average; (2) a sufficient number of landmarks are available; and (3) the deformation was linear. The results exposed difficulties caused by the violation of the three assumptions. First, animals can be very asymmetrical: it is necessary to identify the more symmetrical parts of the animal and limit the data collection to these areas. Second, the number of landmark pairs needed to find the matrix can be quite large. The theoretical minimum is five pairs, but many more are needed because of the inherent redundancy among pairs. In the case of the trilobite, eleven pairs turned out to be insufficient. Third, there are too many alternative solutions without much difference in symmetry scores. Therefore, nearly symmetrical reconstruction of the original animal with incorrect length/width/height ratios could easily mislead researchers. With care, however, it was possible to retrodeform all the specimens. The method will be made available in a software package, including a 3D landmark editor which can also be used for morphometric studies.

THE EARLY EVOLUTIONARY HISTORY OF THE EUREPTILIA (AMNIOTA, REPTILIA)

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Besides the Synapsida and the Parareptilia, the Eureptilia form the third major clade of the Amniota and include popular animals such as dinosaurs, birds, crocodiles, or snakes. Their early evolutionary history, however, is only poorly understood. Early eureptiles can be subdivided into the Captorhinidae, the probably paraphyletic Protorothyrididae, and the basal diapsid clade Araucoscelidia. A problem of this classification is that it is mainly based on cladistic analyses that included only a very few eureptilian representatives. Thus, we are only poorly informed about the more detailed relationships of basal eureptiles, and we do currently not know if protorothyridids are indeed closer to diapsids than to captorhinids, or if all the taxa designated as eureptiles do even belong to this clade. Recent research on the early Eureptilia included the new description of the