Memorial to Heinz Lowenstam  
1912–1993  
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Heinz Lowenstam, professor of paleontology at the California Institute of Technology, and one of the pioneering paleobiologists of modern times, died on June 7, 1993. His broad vision, keen intellect, and above all his infectious enthusiasm for science induced many young scientists to follow in his footsteps.

A Jewish native of Germany, Heinz was born in 1912 in Upper Silesia. His interests in paleontology and geology were sparked both by the local neighborhood fossils and by a lecture of Alfred Wegener, the proposer of continental drift theory. Heinz was educated at the University of Frankfurt and the University of Munich. He carried out his Ph.D. field research in what was then Palestine, in response to the anti-Semitic climate that prevailed in Germany in the 1930s. He spent 18 tumultuous months in the Middle East studying the geology of the eastern Nazareth Mountains, and then returned to Germany.

A week before his Ph.D. exam, a new law was announced which prohibited the awarding of doctoral degrees to Jews. He fled Nazi Germany in 1937 to the United States, carrying with him a letter from his advisors, Dacque and Broili, confirming that he had fulfilled the requirements for a Ph.D. degree. Thanks to the letter, Lowenstam was accepted to the University of Chicago, and after writing up his field results, was awarded a Ph.D. in 1939.

His first appointment was as curator of the Illinois State Museum, where he discovered that the Silurian reef fauna in the Chicago area most closely matched fauna from the same period in Tennessee. This led to a series of much-cited studies that identified concepts of reef formation that have influenced generations of researchers in paleobiology. It also had an important impact on the local petroleum geology. From drill cores, he identified the presence of subterranean Silurian oil-bearing reefs and, by reconstructing the paleoecology of the area, could predict the locations of other such reefs. This discovery contributed significantly to the development of these oil fields at a crucial time during World War II.

Soon after the war he was invited by Nobel prize laureate Harold Urey to join his group as the resident paleoecologist. The group's mission was to measure natural variations in the stable isotopic compositions of biogenic carbonates in order to deduce past ocean temperatures. Heinz was instrumental in obtaining the best fossils, setting up the calibration experiments, and helping to make the key paleontological interpretations of the results. It was, in fact, Heinz who collected the famous belemnites from the Peedee Formation in South Carolina, whose ground-up shells to this day are used as the worldwide standard (PDB) for these measurements. The impact of this group and, in turn, of Heinz himself, on the earth sciences was enormous. As part of this project, Heinz paid increasingly more attention to the careful study of organisms in the living environment as a basis for understanding the past. He worked in Bermuda, the Caribbean, and, in particular, Palau, where the water temperatures and salinities are almost constant. In so doing, he was very much setting the trend and the standards of how modern paleontological work should be done.
In the early 1950s and after moving with many of the original Urey group to Caltech in 1953, Heinz expanded these studies to include not only stable isotope analyses but also trace element analyses, in particular strontium and magnesium concentrations. He made important contributions to the ways in which biologically produced carbonate skeletons could be used as monitors of the ancient environment. He was always keenly aware of just how easily this goal could be clouded or completely obliterated by the ever-present phenomenon of diagenesis. His approach to working around the problem was to monitor as many different variables as possible and to use only the very best preserved fossils. One of his major objectives, which he never did achieve, was to find a parameter, in shells or some other biogenic product, that would be sensitive to hydrostatic pressure and could be used as an indicator of the depths of oceans in the past.

The seeds for his entry into the field of biomineralization were sewn at this time. Heinz's work on the isotopic and trace element compositions of shells frequently pointed to a biological override of the chemical processes, which in turn invited the question How were the skeletons formed? The clincher came with the discovery in 1962 that the teeth of chitons were composed of an outer layer of the iron oxide mineral magnetite. At that time it was thought that this mineral could be produced only at elevated temperatures and pressures, and hence its biological production represented an amazing discovery. In fact, the original report was greeted with much suspicion. Heinz himself realized from this discovery that the world of biomineralization was, for the most part, undocumented, and from this time on, one of his major goals was to elucidate better the distribution and diversity of this rich field. He reasoned that without a broad perspective, we would never be able to home in on the basic underlying processes.

A perusal of the 25 years during which Heinz focused his efforts on the field of biomineralization will not reveal a clear progression of ideas and concepts. That was not his style. In fact, I never ceased to marvel at the completely random manner in which he stumbled onto interesting topics—a chance meeting, or a request from someone to “take a look at this specimen.” These projects sometimes went on for years. He investigated a wide variety of phenomena in this rich world: vateritic spicules of tunicates, the numerous biogenic minerals in living Nautilus, the wine-red amorphous iron phosphate granules of a sea cucumber, a number of different otoliths and otoconia, and his last major project, which involved the discovery of a very unusual bone-like mineralized tissue in a group of barnacles. Heinz tended to focus more on the mineral and ultrastructural side of the subject, but he encouraged several investigators, myself included, to study the biochemistry of the macromolecules that control mineral formation. In all his studies, he paid great attention to the details, but in the back of his mind he was always trying to figure out the big picture. He wrote three major synthesis-type documents: one on the impact of life on the chemistry of the oceans, one landmark review entitled “Minerals Formed by Organisms,” and with me the book *On Biomineralization*. In the minds of many in the field of biomineralization, he will always be regarded as one of its pioneers.

Heinz Lowenstam was actually a pioneer in all the fields he focused on. Now that his rich and productive life has ended, we can look back on the study of Silurian reefs, paleotemperatures, trace elements in shells, biological magnetite, and all the other diverse subjects he worked on in biomineralization, and wonder how one man could have achieved all this. But this is not all. He inspired many young scientists along the way, and as a result, his indomitable scientific spirit still lives on.

**SELECTED BIBLIOGRAPHY OF H. LOWENSTAM**


1951 (with Epstein, S., Bucksbaum, R., and Urey, H. C.) Carbonate-water isotopic temperature


