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Reinhart A. Gygi (1935–2014): Scientific achievements of a life-long commitment to research in Late Jurassic carbonate sedimentology and biostratigraphy of the northern Swiss Jura Mountains

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On November 7th 2014, Reinhart A. Gygi died in his home at the Carl-Spitteler-Strasse 70 in Zürich-Witikon. With him, the scientific community lost the foremost expert of Late Jurassic stratigraphy of the Swiss Jura Mountains, and of Late Jurassic ammonites. During 34 years, he worked as curator at the Natural History Museum Basel, and he was a long-term member of the Swiss Palaeontological Society and the Swiss Geological Society.

Reinhart A. Gygi, citizen of Aarau AG and Kappelen BE, was born in Zürich on November 25th 1935. His father was the engineer Hans Adolf Gygi who would later become director of the Holderbank Cement Mills and himself son of the factory founder Adolf Gygi. His mother was Berta Marilies, born Reinhart. Reinhart spent his early years together with his three siblings in the parental home in Möriken-Wildegg. He attended the primary school in Möriken, secondary and high school in Aarau. An inspiring high-school teacher was responsible that Reinhart became enthusiastic about geology. From 1954 on he stayed in Aarau, first in the house of family friends, then in his aunt Clärli's house. Reinhart finished high school and passed the final exam in March 1956.

In the following summer, Reinhart accompanied his father on a business trip to Canada. There he could work as trainee in a mining company and experienced the hard life of a prospecting geologists searching for iron and nickel ores. In October 1956, Reinhart started to study geology in Zürich, until summer 1957 at the ETH, then at the University of Zürich. During his early study years he already acted as an advisor for civil engineering and highway constructions. In 1961 he had completed the mandatory geological mapping, which he did in his "home range" on the Chestenberg just north of Möriken-Wildegg. This resulted in his first two publications (Hofmann and Gygi 1961; Gygi and Trümpy 1966).

In 1962, Reinhart started working on his PhD thesis. Professor Rudolf Trümpy had proposed to investigate the Upper Jurassic of the canton Aargau, a subject that initially did not promise to be very rewarding to the student, but fieldwork, which was soon extended to the cantons Solothurn and Schaffhausen, yielded very interesting results. Reinhart had by that time already established himself as an expert of Jurassic stratigraphy of the Jura Mountains (Gygi and Stumm 1965; Gygi 1966a; Gygi et al. 1966). First results of his PhD work were published in 1966 (Gygi 1966b), and Reinhart finished his thesis on the Oxfordian of northern Switzerland and was promoted in the autumn of 1967. Reinhart had planned to become prospecting geologist, but Rudolf Trümpy could persuade him to apply for a research job. On December 1st 1967, he started working as research assistant at the Natural History Museum Basel where he could pursue his studies on the Upper Jurassic of northern Switzerland. The first month of the employment he worked without salary that he compensated with a month of travel abroad in April 1968.

From his parents, Reinhart had received a 4WD-truck, a Volvo Laplander, as a present for passing the promotion, and he undertook together with a colleague a longer trip to the Middle East with this vehicle in April 1968. The focus of this trip was rather cultural than geological. Later this truck would also accompany him for fieldwork in many quarries of northern Switzerland. Another stay abroad during his first year at the Natural History Museum of Basel took him in the summer 1968 to Bermuda where he

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studied modern carbonate sedimentation and coral reef formation in a seminar organized by the renowned sedimentologist R. N. Ginsburg. Reinhart brought many coral samples and other zoological and geological specimens back to Basel. These were shown in 1969 in a small exhibit (Gygi 1969c, 1970). The Bermuda stay resulted in some further publications, both scientific and popular (Gygi 1969b, 1972a, 1975a). A few years later, Reinhart could deepen his knowledge at the Third International Coral Reef Symposium in Florida and during accompanying field trips to the Bahamas and Belize.

Upon his return to Switzerland, Reinhart resumed his scientific investigation of the Late Jurassic sediments of northern Switzerland. It was known since the time of Amanz Gressly that the "Malm" in this region showed pronounced lateral facies changes, and up to the times of Reinhart Gygi it remained hotly debated how the different "stage" names in use like Oxfordien, Argovien, Rauracien, Séquanien and Kimméridgien should be employed, and how they could possibly be correlated. Reinhart eventually succeeded in replacing the "historical" stages with the international Oxfordian and Kimmeridgian stages in the whole study area.

Between 1960 and 1995, Reinhart measured and sampled with outstanding persistency more than 200 sections in great detail, quite often on a rope winch that was suspended from the Laplander truck (see Fig. 1). In 1969, his

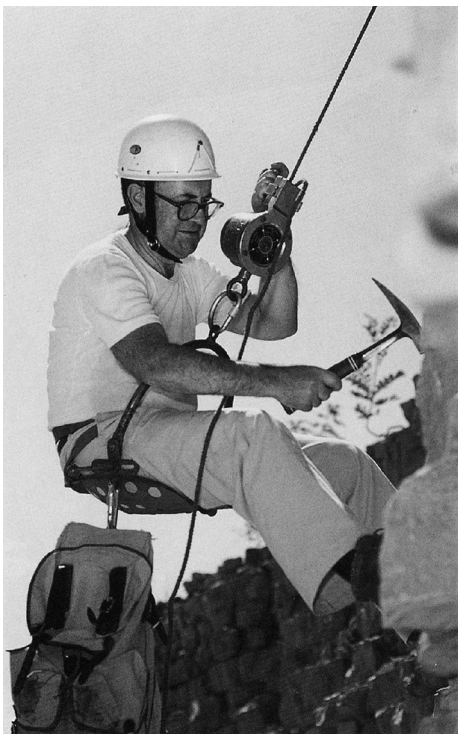

Fig. 1 Reinhart A. Gygi measuring a section suspended on a rope winch that was suspended from his Laplander truck

PhD which focused on the Oxfordian of the canton Aargau was finally published (Gygi 1969a; published material deposited at the Earth Science Department of the ETH Zürich) but in the meantime he had expanded his field studies to the cantons Schaffhausen, Zürich, Solothurn, Baselland, Bern, and Jura (e.g. Gygi 1990a; Gygi and Marchand 1993). He had also started to include sediments of Late Callovian and of Kimmeridgian age. During this work he collected countless and quite often very large sedimentological rock samples, almost 10,000 ammonites, and many other fossils. This material fills around 800 drawers in the Natural History Museum of Basel.

Reinhart married in 1969 Sylvia Näf, citizen of Wattwil SG. The couple would remain childless. In 1970, Reinhart became curator at the geological department of the Basel museum. Although he had initially still hoped to work in foreign, exotic and remote countries as prospecting oil geologist, he stayed at his position in Basel until his retirement in 2001. Apart from 1970, his wife Sylvia who had given up her job as teacher helped him with fieldwork and the preparation of fossils, and also with editing manuscripts and bringing them to the publishing stage. Her help in the scientific career of Reinhart can hardly be overestimated.

His expertise on a variety of sediment types led to a number of popular publications that treated the most common rock types of northern Switzerland (Gygi 1972b, 1973b, c, d, 1974, 1975b, 1981a). The focus of his research, however, remained unchanged, and it was mainly litho- and biostratigraphy and the description of new ammonite species that would keep Reinhart busy for the next decades. His first taxonomic works on ammonites appeared in the late 70s (Gygi 1977; Gygi et al. 1979). Taxonomic papers and carefully written monographs, mostly on perisphinctids, appeared until after his retirement (Gygi and Marchand 1982; Gygi 1990c, 1991a, b, 1995, 1998, 2001, 2003; Gygi and Hillebrandt 1991; Atrops et al. 1992, 1993; Gygi et al. 1994; Mangold and Gygi 1997; Dietl and Gygi 1998; Bonnot and Gygi 1998, 2001; Marchand et al. 2000; Enay and Gygi 2001; Bert et al. 2003). Except for some nautilids (Tintant et al. 2002), Reinhart would confine himself in his palaeontological works to ammonites. More than 20 new species were erected in his publications but quite often based on a single specimen, as taxonomic work was for Reinhart first of all a means for refining the biostratigraphical zonation.

With collaborators, Reinhart refined some of his stratigraphical subdivisions with isotopic ages (Gygi and McDowell 1970; Fischer and Gygi 1987a, b, 1989) and with mineralostratigraphic methods (Gygi and Persoz 1986). In his sedimentological studies, Reinhart concentrated on shallow-marine to intertidal sediments with stromatolites (Gygi 1983b, 1985, 1986, 1992) and coral

reefs (Gygi 1983c), and on iron oolites (Gygi 1981b, Odin et al. 1988) which were still a puzzle when Reinhart started to work on the lowermost Oxfordian of the canton Aargau, the so-called "Cordatus-Schichten", now Schellenbrücke Bed. When Rolf Eichin and Werner Regenass initiated in 1975 a scientific committee for the investigation of the famous Herznach iron mine (WABH: Wissenschaftliche Arbeitsgemeinschaft Bergwerk Herznach) and asked Reinhart for collaboration, he enthusiastically agreed. The research team also included Jürg Ewald, Erich Offermann, Hans Rieber, Rolf Bühler and Dominik Stöcklin, and it excavated and sampled the Cordatus-Schichten which were left during mining and constituted the top of the shafts. Around one thousand ammonite specimens were collected and distributed equally among the research group members. The activity came to an abrupt end when in Mai 1976 in the wake of the Friaul earthquake large parts of the mine collapsed. Initial results were soon published (Gygi and Marchand 1976; Marchand and Gygi 1977), later followed by an extended treatment of the Cardioceratidae (Gygi and Marchand 1982) and the Perisphinctidae (Gygi 1998). Throughout his career, Reinhart also collaborated with other amateur collectors who donated many ammonites for his scientific investigations.

At times, Reinhart had hoped to present a type section for the Oxfordian–Kimmeridgian boundary. In 1974, a large excavation at the locality "Summerhalde" near Schaffhausen had yielded around 1,000 ammonites sampled bed by bed, both from the subboreal (mainly cardioceratids) and from the submediterranean faunal provinces (mainly perisphinctids). Initial results were published on the Cardioceratidae (Atrops et al. 1992, 1993) but a comprehensive treatment of the ammonite fauna (Atrops and Gygi, manuscript plus plates) unfortunately was never finished. In the meantime the Oxfordian–Kimmeridgian boundary was defined in the boreal region and is in the submediterranean province no longer considered to lie between the Planula-zone and the Platynota-zone (Ogg et al. 2012), which were so well represented in the Summerhalde section. This boundary is also the theme of his last publication (Gygi and Morard 2015).

The detailed correlation scheme that Reinhart had developed for the Oxfordian and Kimmeridgian of northern Switzerland, at the boundary of subboreal and mediterranean faunas, aroused the interest of sedimentologists in England and the USA, and a detailed sequence-stratigraphic framework was developed in collaboration with A. L. Coe and P. R. Vail (Coe et al. 1994; Coe and Gygi 1994; Gygi et al. 1998). This correlation scheme of the lithostratigraphic units within a chronostratigraphic framework down to the zonal and in part even the subzonal level, initially published in 1986 (Gygi and Persoz 1986), was refined over the years and is probably the greatest achievement of Reinhart. The final version (Gygi 2012) includes many lithostratigraphic units defined by Reinhart himself (Gygi 2000b, c) of which the large majority is still in use today. His biostratigraphical correlations were based on the classical index fossil approach. Perhaps if based on ammonite associations instead, slightly different and perhaps more reliable results might have been obtained (B. Hostettler, pers. comm.), but this remains contentious. Nevertheless, his scheme for the Oxfordian and Kimmeridgian sediments of northern Switzerland will, perhaps with some modifications, remain the standard for decades, and with respect to its stratigraphical resolution it is among the best in Europe and perhaps worldwide.

This scheme was, over the years, extended to include palaeogeographical reconstructions and water-depth information (Gygi and Persoz 1987; Gygi 1999a, b; Ghasemi-Nejad et al. 1999), and to chart the different formations and members in a context of the depositional environment (Gygi 1986, 2000a, b, 2012). This palaeoenvironmental reconstruction of the lithological units from the carbonate platforms and reefs in the northwest to the deeper basinal settings in the east was Reinhart's ultimate goal and its final version was published in Reinhart's book of 2012, where the overall pattern is possibly described correctly even though the methodology behind it has some obvious shortcuts. Reinhart never saw the sedimentation in the wider context of the tectonic evolution of Europe, and his assumed subsidence and sedimentation rates do not always appear to match the observations. He used palaeoecology basically as a means for the reconstruction of water depth, which he considered as an absolute and easily determinable ecologic factor. Perhaps the most serious deficit of Reinhart's later works was his way of citing. Up to about 1980, he considered the relevant palaeontological and sedimentological literature rather comprehensively. Later on, however, he became more selective, possibly overly citing his own publications.

As a member of the Swiss Palaeontological Society, the Swiss Geological Society, the Association of the Swiss Petroleum geologists and engineers, the Swiss Stratigraphical Committee (Jura east) and the Subcommission for Jurassic Stratigraphy of the German Stratigraphic Commission (DSK), Reinhart led many excursions into his home range (Gygi et al. 1966; Gygi 1973a, 1982a, 1990b, 1999b; Bayer et al. 1983; Gygi and Rieber 1987, 1989) and could vividly demonstrate his findings. He also contributed to the first mini-course organized by the Swiss Palaeontological Society on ammonites (Gygi 1993).

Apart from 1979, Reinhart explicitly confessed to Christianity, and this became increasingly evident in the acknowledgements of his later works. At the Natural History Museum Basel, he was little involved in the daily museum business like curating collections and preparation

of exhibits. Nonetheless, he prepared a small special exhibit about coral reefs in 1969 (Gygi 1969c, 1970) and designed the remarkable fossil gallery (see Gygi 1982b, 1983a) in the permanent exhibit "The Earth" which opened in 1978.

After his retirement in January 2001, Reinhart remained as voluntary collaborator at the museum until the end of 2002 to finish some manuscripts. He then moved with his wife to Männedorf into a nice apartment above Lake Zürich. In 2004, Reinhart moved to Zürich-Witikon into a retirement home. There he felt comfortable, and he decided to publish a last book that would summarise his life's work. Several times a year he travelled to Basel to have a closer look at selected specimens of "his" collection, and to discuss certain topics that seemed important to him. It was of utmost concern to him that the collection and its documentation would remain intact. He therefore also deposited copies of his valuable and accurate field books at the Swisstopo (Landesgeologie) in Wabern and in the ETH geology library in Zürich.

In 2008 Reinhart created the Jura-Foundation (Jura-Stiftung für Sediment- und Strukturgeologie) that supported until 2014 a few stratigraphical and palaeontological works, most notably the Master Thesis of Irene Meier (Meier 2011) and the PhD of Bernhard Hostettler (Hostettler 2014). But the foundation also financed infrastructural projects in less wealthy municipalities of the Jura region.

When the author reordered and labelled the rather large regional-stratigraphic collection "Jura mountains" at the Natural History Museum in Basel in 2011–2012, Reinhart was more than willing to help with problematic objects of the Late Jurassic. Even if with some delay, the Basel collection thus benefitted from his unquestionable competence. On these occasions, we had scientific discussions in a relaxed atmosphere. Reinhart was always thankful for new literature, and he was glad to receive pdfs. However, he could no more be persuaded to buy a memory stick, and therefore many CDs were burnt. Two works of Reinhart appear posthumously: his part on the Upper Jurassic in the explanation of the geological map Balsthal (Gygi 2015), and a paper about the Oxfordian–Kimmeridgian boundary in the Swiss Jura Mountains (Gygi and Morard 2015).

With Reinhart the scientific community lost a scientist who had a comprehensive knowledge of the Late Jurassic of the Swiss Jura Mountains. His most important legacy is the detailed correlation scheme for the Oxfordian and Kimmeridgian of this region. This legacy will most probably stand the test of time and is most notable for its high stratigraphic resolution. Somewhat delayed, Reinhart will be honoured with the naming of a fossil: not with an ammonite as he had perhaps hoped but with an echinoid, *Polycidaris gygii* (Hostettler and Menkveld 2015).

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