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The direction of science is often driven by contemporary theory, and theory emerges from consolidated empirical knowledge. What we know emerges from what we explore, and we explore what we have technical tools for. I feel that technical opportunities contributed strongly towards what is held as a contemporary, widely accepted theory. However, the presumed causality may become reverted, if one accounts for those less explored questions, for which tools are missing. Here, I will reflect on decades of research experience in empirical plant sciences, mainly plant water relations, plant carbon relations and biogeography, during which some mainstream paradigms became challenged. Scientific theory passes through waves and cycles and is even linked to fashion. Insight that seemed established at one time may become outdated by novel concepts facilitated by novel methods, and as time progresses, old concepts may find a revival. In the following chapter, I will illustrate such shifts in awareness and misleading paradigms that were driven by the contemporary availability of methods rather than stringent logics. Examples include plant responses to drought stress; the drivers of plant growth in general, as well as in the context of rising atmospheric CO₂ concentrations; and how physiological plant ecology can contribute to resolving biogeographical questions such as range limits of plant species and plant life forms. My résumé is that explanations of plant responses to the environment are predominantly below ground and require an understanding of developmental and meristematic processes, whereas available tools often lead to attempts at above-ground answers based on primary metabolism (e.g. photosynthesis). Further, well-understood processes at the organ (leaf) level are losing relevance at the community or ecosystem level, where much less understood mechanisms come into action (e.g. stand density control). While the availability of certain convenient methods can open new research arenas, it may also narrow the scope and may direct theory development towards easily measurable parameters and processes.

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