Samson Abramsky (Computer Science, Oxford University): “Contextuality: At the Borders of Paradox.”

Contextuality can be understood as arising where we have a family of data which is locally consistent, but globally inconsistent. From this point of view, it can be seen as a pervasive phenomenon, arising not only in quantum mechanics, but in many other areas. There are also remarkably direct connections to logical paradoxes. One can say that contextual phenomena, which we must accept as key features of our picture of physical reality, lie at the very borders of paradox, but do not cross those borders.

On the qualitative level, we show how a hierarchy of strengths of contextuality emerges naturally in a sheaf-theoretic language, and how the ‘All-versus-Nothing’ arguments which have played an important role in quantum foundations are witnessed by sheaf cohomology as obstructions to global sections. On the quantitative level, we show that all Bell inequalities, for a very general notion of contextuality scenarios, arise uniformly from logical consistency conditions.