In their articles, Thomas Kuhn and Steven Weinberg present vastly different viewpoints not only on the nature of scientific progress, but on the fundamental role of scientific discovery. In Kuhn’s book, he states that scientific progress does not actually progress toward any inevitable destination, but rather meanders around, sometimes more right in the objective sense, sometimes less. Weinberg, on the other hand, believes that in the course of scientific progress, new theories uniformly do a better job of modeling the universe than old ones. This suggests to him that we are, indeed, drawing nearer to some correct picture of objective reality. From my own knowledge of the history of scientific inquiry, and my own experience learning science, it appears that Weinberg’s position on this matter is more correct than Kuhn’s.

Kuhn argues that the field of science (by which he means physics) progresses gradually during what he considers to be periods of “normal” science. This process is interrupted when unexpected results lead to a paradigm shift—a radical change in the body of knowledge that is accepted by the scientific community as truth. Furthermore, the current paradigm defines not only the solutions to problems, but also the very problems which are important. Thus, there is a sense of self-fulfillment about science in that the problems which a paradigm renders important are also those that the current paradigm is best equipped to solve. In Kuhn’s view, scientists pursue those problems which are important at the time; as paradigms change, so too do the problems.

Kuhn’s view of paradigm shifts and changing problems produces some other notable corollaries, as well. For him, a paradigm shift produces such a fundamental
change in the fabric of the scientific landscape that different paradigms are entirely irreconcilable. He uses the example of Einsteinian versus Newtonian mechanics: even though the terminology remains largely the same, the same word (e.g. “mass”) represents two separate concepts which differ subtly, yet fundamentally, according to the paradigm in which the term is used. This incommensurability between different paradigms leads to the notion that scientific progress is not, in fact, cumulative, but rather is interrupted, and essentially begins anew with each paradigm shift. In this way, the direction of progress is driven by the current paradigm, and not by the pursuit of some overriding truth.

Weinberg is, among other things, an experimental scientist, and as such, he reacts rather defensively to Kuhn’s book. Writing in response, Weinberg refutes many of the points made by Kuhn. He argues that different paradigms can be reconciled, and that existing paradigms build upon the old ones. For instance, students still learn Newtonian mechanics before they learn relativity. If anything, being cognizant of different paradigms helps to place both new and old ones in the proper context. Perhaps even more relevantly, Weinberg argues that scientific progress is, in fact, a cumulative process, in which old theories pave the way for new ones. In this way, our knowledge is moving closer and closer to absolute truth. He correctly states that each new theory, throughout the history of science, fits the body of experimental data better than any previous theory. In this way, our theories become more and more accurate, until eventually they will be perfect. In this way, we move closer to discovering truth, Kuhn’s argument notwithstanding.

Weinberg also successfully counters a number of Kuhn’s major points. He states that the difference between pre- and post-relativity Newtonian mechanics given by Kuhn
is really nothing more than a sophisticated word trick. For Weinberg, it is nonsense to say that present-day Newtonian mechanics is a different theory than it was one hundred and fifty years ago, simply because it is now known to be approximate. The final important point in Weinberg’s article is his insight into Kuhn’s methodology in writing his book. He writes that while Kuhn was examining the shift from Aristotelian to Newtonian mechanics he had an epiphany of sorts. That particular shift was momentous, and in examining it, Kuhn took many of his ideas from what occurred in that one instance. According to Weinberg, such a shift has never been duplicated, rendering most of Kuhn’s argument inapplicable to the majority of scientific work.

In my own experience, primarily as a student, Weinberg’s view seems to be far more accurate than that of Kuhn. Science does indeed build upon itself, in a cumulative process, with new ideas following logically from those that precede them. Perhaps this view is tied intrinsically to being a student, as one is limited to learning things which have already been discovered, but I imagine the principle holds for experimental scientists who are actually gaining new knowledge. While older paradigms may be ill-equipped to deal with current problems, they are by no means incomprehensible to modern scientists. Quite simply, current paradigms are more correct than those that they replaced, and are consequently more useful. While algebra is insufficient to solve differential equations, it provides the necessary foundation to find the solution. Likewise, although old paradigms are of no help in solving current problems, knowledge of them is vital to scientific discovery. It is the relation of old paradigms with new through which science progresses.