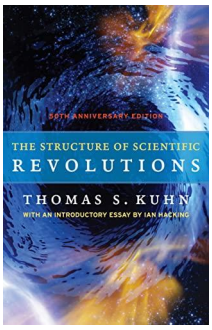

YOUR KINDLE NOTES FOR:

The Structure of Scientific Revolutions: 50th Anniversary Edition

by Thomas S. Kuhn, Ian Hacking

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123 Highlights

Highlight (Yellow) | Location 240

> exemplar, a very best and most instructive example.

Highlight (Yellow) | Location 346

> Discovery comes not when something goes right but when something is awry, a novelty that runs counter to what was expected.

Highlight (Yellow) | Location 350

> We have a tendency to see what we expect, even when it is not there. It often takes a long time for an anomaly to be seen for what it is, something contrary to the established order.

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> If one theory says the sentence is true and another says it is false, there is no contradiction, for the sentence expresses different statements in the two theories, and they cannot be compared.

Highlight (Yellow) | Location 578

> “paradigms.” These I take to be universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners.

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> historians confront growing difficulties in distinguishing the “scientific” component of past observation and belief from what their predecessors had readily labeled “error” and “superstition.”

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> If these out-of-date beliefs are to be called myths, then myths can be produced by the same sorts of methods and held for the same sorts of reasons that now lead to scientific knowledge.

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> If, on the other hand, they are to be called science, then science has included bodies of belief quite incompatible with the ones we hold today.

Highlight (Yellow) | Page 6

> The extraordinary episodes in which that shift of professional commitments occurs are the ones known in this essay as scientific revolutions.

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> the tradition-shattering complements to the tradition-bound activity of normal science.

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> they can also be retrieved from the study of many other episodes that were not so obviously revolutionary.

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> there can be a sort of scientific research without paradigms,

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> In the absence of a paradigm or some candidate for paradigm, all of the facts that could possibly pertain to the development of a given science are likely to seem equally relevant.

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> early fact-gathering is a far more nearly random activity

Highlight (Yellow) | Page 23

> a paradigm is rarely an object for replication.

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> it is an object for further articulation and specification under new or more stringent conditions.

Highlight (Yellow) | Page 24

> Mopping-up operations are what engage most scientists throughout their careers.

Highlight (Yellow) | Page 24

> normal science.

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> No part of the aim of normal science is to call forth new sorts of phenomena;

Highlight (Yellow) | Page 24

> those that will not fit the box are often not seen at all.

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> has drastically restricted vision.

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> those restrictions, born from confidence in a paradigm, turn out to be essential to the development of science.

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> detail and depth

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> the range of anticipated, and thus of assimilable, results is always small compared with the range that imagination can conceive.

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> the project whose outcome does not fall in that narrower range is usually just a research failure, one which reflects not on nature but on the scientist.

Highlight (Yellow) | Page 35

> Even the project whose goal is paradigm articulation does not aim at the unexpected novelty.

Highlight (Yellow) | Page 38

> the conviction that, if only he is skilful enough, he will succeed in solving a puzzle that no one before has solved or solved so well.

Highlight (Yellow) | Page 46

> That scientists do not usually ask or debate what makes a particular problem or solution legitimate tempts us to suppose that, at least intuitively, they know the answer. But it may only indicate that neither the question nor the answer is felt to be relevant to their research.

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> Normal science can proceed without rules only so long as the relevant scientific community accepts without question the particular problem-solutions already achieved.

Highlight (Yellow) | Page 52

> Normal science does not aim at novelties of fact or theory and, when successful, finds none.

Highlight (Yellow) | Page 52

> Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the paradigm-induced expectations that govern normal science. It then continues with a more or less extended exploration of the area of anomaly. And it closes only when the paradigm theory has been adjusted so that the anomalous has become the expected.

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> consciously or not, the decision to employ a particular piece of apparatus and to use it in a particular way carries an assumption that only certain sorts of circumstances will arise.

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> Paradigm procedures and applications are as necessary to science as paradigm laws and theories, and they have the same effects. Inevitably they restrict the phenomenological field accessible for scientific investigation at any given time.

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> theory-induced.

Highlight (Yellow) | Page 61

> during pre-paradigm periods and during the crises that lead to large-scale changes of paradigm, scientists usually develop many speculative and unarticulated theories that can themselves point the way to discovery. Often, however, that discovery is not quite the one anticipated by the speculative and tentative hypothesis.

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> Only as experiment and tentative theory are together articulated to a match does the discovery emerge and the theory become a paradigm.

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> novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation.

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> Initially, only the anticipated and usual are experienced even under circumstances where anomaly is later to be observed.

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> Further acquaintance, however, does result in awareness of something wrong or does relate the effect to something that has gone wrong before.

Highlight (Yellow) | Page 64

> That awareness of anomaly opens a period in which conceptual categories are adjusted until the initially anomalous has become the anticipated.

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> At this point the discovery has been completed.

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> Without the special apparatus that is constructed mainly for anticipated functions, the results that lead ultimately to novelty could not occur.

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> even when the apparatus exists, novelty ordinarily emerges only for the man who, knowing with precision what he should expect, is able to recognize that something has gone wrong.

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> Anomaly appears only against the background provided by the paradigm. The more precise and far-reaching that paradigm is, the more sensitive an indicator it provides of anomaly and hence of an occasion for paradigm change.

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> resistance guarantees that scientists will not be lightly distracted and that the anomalies that lead to paradigm change will penetrate existing knowledge to the core.

Highlight (Yellow) | Page 76

> So long as the tools a paradigm supplies continue to prove capable of solving the problems it defines, science moves fastest and penetrates most deeply through confident employment of those tools.

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> retooling is an extravagance to be reserved for the occasion that demands it.

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> the act of judgment that leads scientists to reject a previously accepted theory is always based upon more than a comparison of that theory with the world.

Highlight (Yellow) | Page 77

> The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature and with each other.

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> By themselves they cannot and will not falsify that philosophical theory, for its defenders will do what we have already seen scientists doing when confronted by anomaly. They will devise numerous articulations and ad hoc modifications of their theory in order to eliminate any apparent conflict.

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> if a typical pattern,

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> is applicable here, these anomalies will then no longer seem to be simply facts. From within a new theory of scientific knowledge, they may instead seem very much like tautologies, statements of situations that could not conceivably have been otherwise.

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> scientists fail to reject paradigms when faced with anomalies or counterinstances. They could not do so and still remain scientists.

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> some men have undoubtedly been driven to desert science because of their inability to tolerate crisis.

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> there is no such thing as research in the absence of any paradigm. To reject one paradigm without simultaneously substituting another is to reject science itself.

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> no paradigm that provides a basis for scientific research ever completely resolves all its problems.

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> Excepting those that are exclusively instrumental, every problem that normal science sees as a puzzle can be seen, from another viewpoint, as a counterinstance and thus as a source of crisis.

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> its object is to solve a puzzle for whose very existence the validity of the paradigm must be assumed. Failure to achieve a solution discredits only the scientist and not the theory.

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> “It was as if the ground had been pulled out from under one, with no firm foundation to be seen anywhere, upon which one could have built.”

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> explicit recognitions of breakdown are extremely rare,

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> the effects of crisis do not entirely depend upon its conscious recognition.

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> crisis may end with the emergence of a new candidate for paradigm

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> ensuing battle over its acceptance.

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> it is a reconstruction of the field from new fundamentals,

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> changes some of the field's most elementary theoretical generalizations as well as many of its paradigm methods and applications.

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> How do scientists proceed when aware only that something has gone fundamentally wrong at a level with which their training has not equipped them to deal?

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> scientific revolutions are here taken to be those non-cumulative developmental episodes in which an older paradigm is replaced in whole or in part by an incompatible new one.

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> the sense of malfunction that can lead to crisis is prerequisite to revolution.

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> need seem revolutionary only to those whose paradigms are affected by them.

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> Like the choice between competing political institutions, that between competing paradigms proves to be a choice between incompatible modes of community life.

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> the choice is not and cannot be determined merely by the evaluative procedures characteristic of normal science,

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> for these depend in part upon a particular paradigm,

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> there is no standard higher than the assent of the relevant community.

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> paradigms differ in more than substance, for they are directed not only to nature but also back upon the science that produced them.

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> as the problems change, so, often, does the standard that distinguishes a real scientific solution from a mere metaphysical speculation, word game, or mathematical play.

Highlight (Yellow) | Page 109

> paradigms provide scientists not only with a map but also with some of the directions essential for map-making.

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> learning a paradigm the scientist acquires theory, methods, and standards together, usually in an inextricable mixture.

Highlight (Yellow) | Page 109

> when paradigms change, there are usually significant shifts in the criteria determining the legitimacy both of problems and of proposed solutions.

Highlight (Yellow) | Page 112

> at times of revolution, when the normal-scientific tradition changes, the scientist’s perception of his environment must be re-educated—in

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Highlight (Yellow) | Page 112

> The assimilation of a previously anomalous visual field has reacted upon and changed the field itself.

Highlight (Yellow) | Page 113

> What a man sees depends both upon what he looks at and also upon what his previous visual-conceptual experience has taught him to see.

Highlight (Yellow) | Page 120

> Did these men really see different things when looking at the same sorts of objects?

Highlight (Yellow) | Page 120

> they pursued their research in different worlds?

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> even the most striking past success provides no guarantee that crisis can be indefinitely postponed.

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> though the world does not change with a change of paradigm, the scientist afterward works in a different world.

Highlight (Yellow) | Page 122

> Given a paradigm, interpretation of data is central to the enterprise that explores it.

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> Paradigms are not corrigible by normal science at all.

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> normal science ultimately leads only to the recognition of anomalies and to crises.

Highlight (Yellow) | Page 123

> No ordinary sense of the term ‘interpretation’ fits these flashes of intuition through which a new paradigm is born.

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> only after experience has been thus determined that the search for an operational definition or a pure observation-language can begin.

Highlight (Yellow) | Page 130

> postrevolutionary science invariably includes many of the same manipulations, performed with the same instruments and described in the same terms, as its prerevolutionary predecessor.

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> ultimately created an anomaly where there had been none before.

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> tradition of normal science. In taking

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> What causes the group to abandon one tradition of normal research in favor of another?

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> it is just the incompleteness and imperfection of the existing data-theory fit that, at any time, define many of the puzzles that characterize normal science.

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> It makes a great deal of sense to ask which of two actual and competing theories fits the facts better.

Highlight (Yellow) | Page 148

> The proponents of competing paradigms are always at least slightly at cross-purposes.

Highlight (Yellow) | Page 153

> Probably the single most prevalent claim advanced by the proponents of a new paradigm is that they can solve the problems that have led the old one to a crisis. When it can legitimately be made, this claim is often the most effective one possible.

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> The claim to have solved the crisis-provoking problems is, however, rarely sufficient by itself.

Highlight (Yellow) | Page 154

> Nor can it always legitimately be made.

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> the new theory is said to be “neater,” “more suitable,” or “simpler” than the old.

Highlight (Yellow) | Page 156

> The early versions of most new paradigms are crude. By the time their full aesthetic appeal can be developed, most of the community has been persuaded by other means.

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> a new candidate for paradigm had to be judged from the start by hard-headed people who examined only relative problem-solving ability, the sciences would experience very few major revolutions.

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> the issue is which paradigm should in the future guide research on problems many of which neither competitor can yet claim to resolve completely.

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> have faith that the new paradigm will succeed with the many large problems that confront it, knowing only that the older paradigm has failed with a few.

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> A decision of that kind can only be made on faith.

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> Something must make at least a few scientists feel that the new proposal is on the right track, and sometimes it is only personal and inarticulate aesthetic considerations that can do that.

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> the insulation of the scientific community from society permits the individual scientist to concentrate his attention upon problems that he has good reason to believe he will be able to solve.

Highlight (Yellow) | Page 164

> the scientist need not choose problems because they urgently need solution and without regard for the tools available to solve them.

Highlight (Yellow) | Page 171

> If we can learn to substitute evolution-from-what-we-do-know for evolution-toward-what-we-wish-to-know, a number of vexing problems may vanish in the process.

Highlight (Yellow) | Page 178

> Usually individual scientists, particularly the ablest, will belong to several such groups either simultaneously or in succession.

Highlight (Yellow) | Page 192

> But people do not see stimuli; our knowledge of them is highly theoretical and abstract.

Highlight (Yellow) | Page 192

> Instead they have sensations, and we are under no compulsion to suppose that the sensations of our two viewers are the same.

Highlight (Yellow) | Page 193

> Individuals raised in different societies behave on some occasions as though they saw different things.

Highlight (Yellow) | Page 201

> both their everyday and most of their scientific world and language are shared.

Highlight (Yellow) | Page 202

> what the participants in a communication breakdown can do is recognize each other as members of different language communities and then become translators.

Highlight (Yellow) | Page 203

> men just entering the profession, for they have not yet acquired the special vocabularies and commitments of either group.

Highlight (Yellow) | Page 204

> as argument piles on argument and as challenge after challenge is successfully met, only blind stubbornness can at the end account for continued resistance.

Highlight (Yellow) | Page 204

> translate a theory or worldview into one’s own language is not to make it one’s own. For that one must go native, discover that one is thinking and working in, not simply translating out of, a language that was previously foreign.

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> That transition is not, however, one that an individual may make or refrain from making by deliberation and choice, however good his reasons for wishing to do so. Instead, at some point in the process of learning to translate, he finds that the transition has occurred, that he has slipped into the new language without a decision having been made.

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> accuracy of prediction, particularly of quantitative prediction; the balance between esoteric and everyday subject matter; and the number of different problems solved.

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> simplicity, scope, and compatibility with other specialties.

Highlight (Yellow) | Page 206

> Later scientific theories are better than earlier ones for solving puzzles in the often quite different environments to which they are applied.