Ж Sciencepolice-14. June 2011.

1) Science is the generation, judging and honing of theories which model (i.e. explain or predict) the best. Only this counts so distinctions between theory, hypothesis, conjecture etc. are artificial.

2) The worth of a theory depends on such aspects as accuracy, generality, simplicity, and the degree to which its implications are genuine predictions (and the more surprising the better).

3) Theories can be rejected individually for not explaining evidence, or judged against each other.

4) An attempt to refute a theory does not require a replacement to be offered. Science isn't politics.

5) It can be good science merely to "rough out" a theory or a class of theories for consideration.

6) A theory is refuted only when all its reasonable instantiations are refuted, not just one. Fixing faults in a theory can mar its other qualities, yet repair is still basic to knowledge development.

7) Extraordinary claims do not require extraordinary evidence and might need no new evidence: to require it would assume theorists in the field have been perfect; it's perfectly possible people just haven't thought of the new theory before. Theories do not spring automatically from observations.

8) New theories can violate and replace the old if the whole knowledge base's modelling improves. Theories must swim amongst others at various levels, but it's no good saying "It gets so complex it's impossible". Popper-based knowledge engineering *works*, even with complex uncertainties, but it's guidelines, not pure mathematics. It underlies scientific experimentation and supports natural and artificial minds. Wet-ware has survived by aping it, always roughly, for over a billion years.

9) There are no absolute facts, proofs or truths; outside mathematics at least, they are convenient untruths that can simplify our thinking. Proof needs to demonstrate the impossibility of *any* competing theory, known *or not*, of equivalent or superior power, whereas disproof merely requires the presentation of evidence inconsistent with the one theory. Knowledge is beliefs, not facts.

10) Evidence is those observations not well explained by a theory, or not as well explained by one theory as by another. Positive but non-comparative evidence (explained by a theory), though useful in the black art of generation, merely progresses testing. 'Positive evidence' must not be trumpeted as 'evidence for' a theory when competing theories also explain it. Papers and journals should ensure the full landscape and pattern of posable theories are reasonably accounted for.

11) An untestable theory is one which is intrinsically logically untestable, not one for which no technique for testing it is yet known to some person, or indeed anyone. Deducing the scope of implications, effects, or influences of a hypothesis (via which it might be tested) can be slow and unending. 'Untestable' is a rare category, not to be routinely flung at everyone else's new theory.

12) Tests a new theory can uniquely pass are best offered, and may be needed for superiority, but not for pseudo-criteria like theory status, false 'testability', or truth. Insisting on a mechanism for a theory is a classic error. A theory often inspires the discovery of its mechanisms and special tests.

13) Strictures apply to judging theories but not to generating them. Judging a theory by the 'worth' or number of its supporters is unscientific: good ideas too often start with a single supporter of little renown. Far from being essential scientific principles, the only value of 'peer review' and 'consensus' is the extent, if any, to which they aid implementation of the genuine principles; their habit of repressing good new theories needs conscious and constant forfending.

14) Historical disciplines (e.g. palaeontology and archaeology) often test by future discovery, not experiment. In such disciplines, evidence and demonstration may be probabilistic or qualitative, and rely on complex variously valid world models left in individual minds by diverse experiences. Typically, historical sciences theorise past events given present evidence (abduction). Inductive sciences invent laws, or describe/model structures or processes; 'applied sciences' deduce futures or achieve goals. Despite differences, many principles apply to all sciences, though the importance of repeatability for inductive sciences does not make it a basic principle of historical disciplines.