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The Large-Scale Structure of Inductive Inference

1. The Material Theory of Induction, Briefly

The material theory of induction is introduced and its application to a range of types of inductive inference is illustrated. The theory asserts that there are no universal rules or schema for inductive inference. Instead, inductive inferences or relations of inductive support are warranted by facts specific to the domain of application.

Part I. General Claims and Arguments

2. Large-Scale Structure: Four Claims

The main claims concerning the large-scale structure of inductive inference are introduced and defended:

1. Relations of inductive support have a non-hierarchical structure.

2. Hypotheses, initially without known support, are used to erect non-hierarchical structures.

3. Locally deductive relations of support can be combined to produce an inductive totality.

4. There are self-supporting inductive structures.

The remaining chapters provide further defenses of the claims and illustrations of them.

3. Circularity

The non-hierarchical relations of inductive support in science admit circularities of large and small extent. These circularities are benign. They do not force contradictions or assured undetermination of facts in the structure. In this regard, they are no different from benign circularities common elsewhere in the sciences, where there is no presumption that the mere presence of a circularity dooms the structure.

4. The Uniqueness of Domain-Specific Inductive Logics

Might a single body of evidence support factually competing theories equally well? The result would be inductive anarchy, since the competing theories would warrant competing

inductive logics. This anarchy is precluded by an instability in the inductive competition between such theories. A small evidential advantage by one secures more favorable facts that amplify its advantage at the expense of competing theories.

5. Coherentism and the Material Theory of Induction

The circularities among relations of support in the material theory of induction are similar to the circularities of justification in a coherentist theory of justification in epistemology. This similarity is superficial. The coherentist theory concerns beliefs and the mental operations that connect them. Inductive inference concern logical relations among propositions independent of our thoughts and beliefs. Contrary to my initial expectations, the resources of coherentist epistemology prove to be of little help or relevance to the material theory of induction.

6. The Problem of Induction

The problem of induction lies in the failure of universal rules of induction to be justified. They must either justify themselves or enter into an infinite regress of justification by distinct rules. The material theory of induction dissolves the problem since it has no universal rules of induction. Attempts to resurrect the problem in the regresses and vicious circularities within the non-hierarchical relations of support fail.

Part II. Historical Case Studies

7. The Recession of the Nebulae

Hubble's 1929 finding that nebulae recede with a velocity proportional to their distance may appear to be a simple generalization from measurements of specific nebulae to a generalization over all nebulae. However, Hubble's 1929 analysis did not respect any hierarchy of generalizations. Since he lacked distance measurements for nearly half the nebulae in his data set, he needed a complicated set of intersecting inductive inferences to recover his result.

8. Newton on Universal Gravitation

Newton's celebrated argument for universal gravitation contains two cases of pairs of propositions such that each deductively entails the other member of the pair. While the individual inferences of this arch-like structure are deductive, its overall import is

inductive and it is the more secure for being constructed form deductive component inferences, rather than inductive component inferences.

9. Mutually Supporting Evidence in Atomic Spectra

Atomic emission spectra were observed in the nineteenth century and early twentieth century to be grouped into distinct series. By means of the Ritz combination principle, evidence of the structure of some series supports the structure of others; and vice versa, forming many relations of mutual support. The Ritz combination principle itself initially supplied evidential support for the nascent quantum theory. Soon, the more developed quantum theory provided support for a corrected version of the Ritz combination principle.

10. Mutually Supporting Evidence in Radiocarbon Dating

Historical artefacts can be dated by traditional methods of history and archaeology or by the method of radiocarbon dating. The results of each method were used to check and calibrate the results of the other method. When the two sets of results are well-adjusted, they mutually support each other, illustrating the arch-like structure of relations of support.

11. The Determination of Atomic Weights

It took over half a century after Dalton proposed his atomic theory of the elements for chemists to break a circularity in molecular formulae and atomic weights and establish that water is H_2O, and not HO, or HO_2, or H_4O, and so on. Their analysis employed relations of inductive support of bewildering complexity at many levels, from that of quite specific substances to that of general theory. Their efforts illustrate the complex, non-hierarchical character of relations of inductive support.

12. The Use of Hypotheses in Determining Distances in Our Planetary System

As late as the eighteenth and nineteenth centuries, astronomers still struggled to provide exact values for distances within our planetary system. Triangulation, also called parallax in astronomy, was the only direct method available. It was too weak. Since antiquity, astronomers were only able to arrive at definite results by supplementing their analyses with hypotheses that would in turn require subsequent support. Early hypotheses failed to find this support. Copernicus' heliocentric hypothesis succeeded.

13. Dowsing: The Instabilities of Evidential Competition

The instability of competition among competing theories is illustrated by the rivalry between proponents and critics of dowsing. Over four centuries, they competed at the level of theory, advancing different conceptions of the processes at issue; and at the level of phenomena, disputing whether the downing successes were pervasive or illusory. Mutually reinforcing evidential successes by critics eventually led to securing their position at the expense of the dowsers', whose views were reduced to a pseudoscience.

14. Stock Market Prediction: When Inductive Logics Compete

Four systems are routinely used now to predict future prices on the stock market, each comprising a small inductive logic. Each is based on a factual hypothesis concerning stock price dynamics. Since the hypotheses disagree in factually ascertainable matters, their competition is unstable. Only one would survive if investors and pundits fully pursued and took proper notice of the evidence.

Epilog