Dr. Chuck's Cheat-Sheet on the Received View

Most Important Ideas of the Received View

The Three Components (We Discuss)

(1) Laws, Theories, and Explanations
(2) Logical/Linguistic Structure of Science
(3) Unity of Science

Laws, Theories, and Explanations

Modified Table of Explananda and Explanatory Form From Salmon

		Explananda By Type (Generality)	
	Relevant Covering Laws	Particular Facts	General Regularities
Explananda by Type (of law)	Universal Laws	D-N Deductive-Nomological	D-N Deductive-Nomological
	Statistical Laws	I-S Inductive-Statistical	D-S Deductive-Statistical

The Notion of Law and its Explication in Terms of a Law-like Statement

Fundamental: In accordance with the considerations developed in section 6, we now define:

(7.3a) *S* is a fundamental law-like sentence in L if *S* is purely universal; *S* is a fundamental law in L if *S* is purely universal and true. (H&O p.158)

Derived: Any universal law that can be deduced from fundamental laws.

(7.3b) *S* is a derivative law in L if (1) *S* is essentially, but not purely, universal
and (2) there exists a set of fundamental laws in L which has *S* as a consequence. (H&O p.158)

Closure Principle*:*

(7.3c) *S* is a law in L if it is a fundamental or a derivative law in L. (H&O p.158)

Note all logical truths are fundamental laws under this set of definitions, as H&O note (p.159)

The Conditions On/Properties Of Law-like sentences

Only true sentences are classified as law-sentences; law-like sentences have all

the characteristics of law-sentences, with the possible exception of truth. Thus every law-sentence is a law-like sentence, but not all law-like sentences are laws. Informally, law-like sentences have four properties:
(1) Law-like sentences have universal form (Note here, it is not merely the form, it is the counterfactual [modal] import of laws.).
(2) Law-like sentences have unlimited scope (Note many "idealized laws," do not have unlimited applicability.).
(3) Law-like sentences do not contain designations of particular objects, and (this together with 2 are widely seen as creating the problem on determining the difference between laws and accidental generalizations. Specifically, the parties Salmon mentions look towards an linguistic/conceptual distinction. Looking at, for example, Salmon's apple example or Goodman's grue example, the assumed solution, that laws have the necessary relevance relationships, whereas accidental generalizations lack such relevance conditions, is implicit in this project.).
(4) Law-like sentences contain only purely qualitative predicates. (Salmon, p. 13) (Note: The definition of a qualitative predicate is essentially that of a predicate, the extension of which makes no reference to individuals. This strikes me as hopeless given that standard semantics allows interpretations for predicates by specification of their members, and by definite description. Note too that no definition is given in H&O, who candidly indicate it's undesirable vagueness. H&O note that they are largely adopting Carnap's terminology, which he also does not define formally. As Salmon notes: "Lawfulness, modal import, and support of counterfactuals seem to have a common extension; statements either possess all three or lack all three. But it is extraordinarily difficult to find criteria to separate those statements that do from those that do not. The three characteristics form a tight little circle. If we knew which statements are lawful, we could determine which statements have modal import and support counterfactuals. But the way to determine whether a statement has modal import is to determine whether it is a law." [Salmon, p.15-16])

The Notion of a Theory and its Use in Explicating Explanation

"It will be convenient to state our criteria for a sound explanation in the form of a definition for the expression 'the ordered couple of sentences, *(T, C),* constitutes an explanans for the sentence *E.'"* (H&O, p.159)

The explanation of a phenomenon may involve generalized sentences which are not of universal form. We shall use the term "theory" to refer to such sentences, and we define this term by the following chain of definitions:

[**Fundamental Theory**]

(7.4a) *S* is a fundamental theory if *S* is purely generalized and true.

[Derivative Theory]

(7.4b) *S* is a derivative theory in *L* if (1) *S* is essentially, but not purely, generalized and (2) there exists a set of fundamental theories in *L* which has *S* as a consequence.

[Closure Clause]

(7.4c) S is a theory in *L* if it is a fundamental or a derivative theory in *L.* (H&O, p.159)

H&O Initial Definition of Necessary Conditions for Potential Explanations

(7.5) An ordered couple of sentences, *(T, C),* constitutes a potential explanans for a singular sentence *E* only if:
(1) *T* is essentially generalized and *C* is singular. [Logical]
(2) E is derivable in L from *T* and *C* jointly, but not from *C* alone. [Logical] (H&O, p.160)

H&O Initial Definition of Conditions for Explanations

(7.6) An ordered couple of sentences, *(T, C),* constitutes an explanans for a singular sentence *E* if and only if
(1) (T, C) is a potential explanans for *E.* [Logical]
(2) T is a theory and *C* is true. [Empirical](H&O, p.160)

Difficulty to be Addressed

Non-trivial Partial Explanation is Allowed

(7.7) Theorem. Let *(T, C)* be a potential explanans for the singular sentence *E.* Then there exist three singular sentences, E_1 , E_2, and *C1* in *L* such that *E* is equivalent to the conjunction $E_1 \bullet E_2$,*C* is equivalent to the conjunction C1 • E_1 ,and E_2 can be derived in *L* from *T* alone. (H&O p.162)

Salmon initially characterizes the problem as “Evidently, some restriction must be placed on the singular sentence C that is to serve as the statement of antecedent conditions in the explanans.” (p.20) I (Wallis) have suggested that the problem seems to lie in the fact that L has no mechanisms for relevance besides truth preservation and L is monotonic. Salmon, however, differs with me when he suggests that Kim’s solution, “(4) E must not entail any conjunct of the conjunctive normal form of C.” Provides an adequate technical fix. (Salmon p.23) While this excludes one simple form of trivial linkage in proof, it does not really fix relevance problems.

Final Definition of Necessary Conditions for Potential Explanations

(7.8) An ordered couple of sentences, *(T, C),* constitutes a potential explanans for a singular sentence *E* if and only if the following conditions are satisfied:
(1) *T* is essentially generalized and C is singular
(2) E is derivable in *L* from *T* and *C* jointly
(3) T is compatible with at least one class of basic sentences which has *C* but not *E* as a consequence. (H&O p.163-4)

Definition of “Explainable” by T

(7.9) A singular sentence *E* is explainable by a theory *T* if there exists a singular sentence *C* such that *(T, C)* constitutes an explanans for *E.* (H&O p.164)

Final (Implicit) Definition of Necessary Conditions for Explanations

(*7.10) An ordered couple of sentences, *(T, C),* constitutes an explanans for a singular sentence *E* if and only if
(1) E is explainable by *T.* (Logical)
(2) T is a theory and *C* is true. (Empirical)

Symmetry of Explanation and Prediction

Finally, candidacy for partial explanation consists exclusively in derivability relative to in *L* (via nested definition of "explainable") of explananda (i.e., *E*) from explanans (i.e., <*T*,*C*>). Explanation consists of sound derivation. As a result, the discipline associates the received view with H&O holding that their theory differentiates explanation and prediction only relative to the truth of *E* at some time *t*. [Actually, this is somewhat of a mischaracterization in that their theory actually differentiates potential explanations from predictions only relative to the truth of *E* at some time *t*.] H&O claim the following:

> Let us note here that the same formal analysis, including the four necessary conditions, applies to scientific prediction as well as to explanation. The difference between the two is of a pragmatic character. If *E* is given, i.e. if we know that the phenomenon described by *E* has occurred, and a suitable set of statements *C1* , *C2* , ... , *Ck, Ll* , *L2* , ... , *Lr* is provided afterwards, we speak of an explanation of the phenomenon in question. If the latter statements are given and *E* is derived prior to the occurrence of the phenomenon it describes, we speak of a prediction. It may be said, therefore, that an explanation is not fully adequate unless its explanans, if taken account of in time, could have served as a basis for predicting the phenomenon under consideration. Consequently, whatever will be said in this article concerning the logical characteristics of explanation or prediction will be applicable to either, even if only one of them should be mentioned. (H&O, p.138)

Conditions Modified to Include Statistical Explanations (From Salmon)

Logical conditions:

1. An explanation is an argument having correct logical form (either deductive or inductive).
2. The explanans must contain, essentially, at least one general law (either universal or statistical).
3. The general law must have empirical content.

Empirical condition:

4. The statements in the explanans must be true.

Relevance condition:

5. The requirement of maximal specificity. (Salmon, p.58)

Logical/Linguistic Structure of Science

The Linguistic Hierarchy

Science operates via mapping relations between distinct classes of languages

The Language of Science:

The language of science class refers to the languages in which each science expresses itself. These Languages are further divided into sub-classes (a) the logico-mathematical terms and (b) the physical language in which science is constructed.

The Thing Language:

The thing language class refers to those languages in which in which we pre-theoretically (Quine calls this the object-language) describe and understand the world.

The Observation Language:

The observation or “observable-things” language contains predicates of direct observation free of object and disposition connotations.

Inter-Theoretic Reduction as Inter-Linguistic Reduction

The notion of reductive statements:

These statements are, at least initially, reductive bridge laws that define terms/concepts in one language in terms the terms/concepts of the other language. These bridge laws work by defining operations in one language for verifying (or asserting) the term/concept in the other language. However, bridge laws already have two formats in Carnap.

Definitional Bridge Laws: DBLs relate concepts in one language to concepts in another language by expressing operations in the first language that are individually necessary and jointly sufficient for membership in the term/concept in the second language.

“Sufficient Reductive Basis” Bridge Laws: SRBBLs relate concepts in one language to concepts in the other language by expressing operations in the first language that are sufficient for membership in the term/concept in the second language.
individually necessary and jointly sufficient operations–definitionally--or conditionally (using a “sufficient reduction basis”)

> Example of a reduction statement for 'elastic': 'If the body *x* is stretched and then released at the time *t,* then: *x* is elastic at the time *t* ≡ *x* contracts at *t,'* where the terms 'stretched,' 'released,' and 'contracting' can be defined by observable thing-predicates. ... For every term of that language is such that we can apply it either on the basis of direct observation or with the help of an experiment for which we know the conditions and the possible result determining the application of the term in question. Now we can easily see that every term of the *physical language* is reducible to those of the thing-language and hence finally to observable thing-predicates. For any such term the physicist knows at least one method of determination. Physicists would not admit into their language any term for which no method of determination by observations were given. The formulation of such a method, Le., the description of the experimental arrangement to be carried out and of the possible result determining the application of the term in question, is a reduction statement for that term. (Carnap p.399)

> If a certain language (e.g., a sublanguage of the language of science, covering a certain branch of science) is such that every term of it is reducible to a certain set of terms, then this language can be constructed on the basis of that set by introducing one new term after the other by reduction statements. In

this case we call the basic set of terms a *sufficient reduction basis* for that language." (Carnap p.398)

The Full-Notion of the Logic of Science

Though Carnap focuses exclusively upon inter-theoretic/inter-linguistic aspects of the logic of science, We should note that the full notion of the Logic of Science (explicated in Dr. Chuck's Evil Logic of Science Handout) includes the syntax of the languages involved in science, the "Transformational Axiom System," and the semantics of the languages involved in science.

Unity of Science

Three Degrees and Two Senses of Scientific Unity

(D1) Unity of Language:

Unity of Science as Unity of Language asserts that the terms of all sciences reduce (in some sense) to one (fundamental, i.e., Physics) science.

> First, unity of science in the weakest sense is aHained to the extent to which all the terms of science are reduced to the terms of some one discipline (e.g., physics, or psychology). This concept of *unity of language* (12) may be replaced by a number of subconcepts depending on the manner in which one specifies the notion of "reduction" involved. (P&O, p. 405)

(D2) Unity of Laws:

Unity of Science as Unity of Laws asserts that the reductions of terms of all sciences to one (fundamental, i.e., Physics) science is a law-preserving reduction.

> Second, unity of science in a stronger sense (because it implies unity of language, whereas the reverse is not the case) is represented by *unify of laws* (12). It is attained to the extent to which the laws of science

> become reduced to the laws of some one discipline. (P&O, p.406)

(D3) Unity of a Coherent Hierarchy:

P&O are a bit vague in characterizing this sense of unity. However, if one takes one's cue in understanding this last sense from the picture painted by P&O, then the third sense might go as follows: Unity of Science as Unity of a Coherent Hierarchy asserts that the reductions of terms of all sciences to one (fundamental, i.e., Physics) science is a law-preserving reduction creating a coherent and hierarchical set of levels within the sciences reflecting the coherent and interconnected nature of the fundamental science.

> Third, unity of science in the strongest sense is realized if the laws of science are not only reduced to the laws of some one discipline, but the laws of that discipline are in some intuitive sense "unified" or "connected." (P&O, p.406)

(S1) The Ideal State Sense of Unity of Science:

The Ideal State Sense Unity of Science asserts that reductions of terms of all sciences to one (fundamental, i.e., Physics) science through a law-preserving reduction is realizable.

> That unity of science, in this sense, can be fully realized constitutes an overarching metascientific hypothesis which enables one to see a unity in scientific activities that might otherwise appear disconnected or unrelated, and which encourages the construction of a unified body of knowledge. (P&O, p.406)

(S2) The Trend Sense of Unity of Science:

The Trend Sense Unity of Science asserts that reductions of terms of all sciences to one (fundamental, i.e., Physics) science through a law-preserving reduction actually describes a trend in the development of science.

In the second sense, unity of science exists as a trend within scientific inquiry, whether or not unitary science is ever attained, and notwithstanding the simultaneous existence, (and, of course, legitimacy) of other, even *incompatible,* trends. (P&O, p.406)

Necessary Conditions For Unity Through Microreduction

(1) There must be several levels.
(2) The number of levels must be finite.
(3) There must be a unique lowest level (Le., a unique "beginner" under the relation 'potential micro reducer'); this means that success at transforming all the *potential* microreductions connecting these branches into *actual* microreductions must, *ipso facto,* mean reduction to a single branch.
(4) Any thing of any level except the lowest must possess a decomposition into things belonging to the next lower level. In this sense each level, will be as it were a "common denominator" for the level immediately above it.
(5) Nothing on any level should have a part on any higher level.
(6) The levels must be selected in a way which is "natural" and justifiable from the standpoint of present-day empirical science. In particular, the step from any one of our reductive levels to the next lower level must correspond to what is, scientifically speaking, a crucial step in the trend toward over-all physicalistic reduction. (P&O, p.409)

Definition of (Micro) Reduction

The principal requirements may be summarized as follows: given two theories T1 and T2, T2 is said to be *reduced* to T1 if and only if:

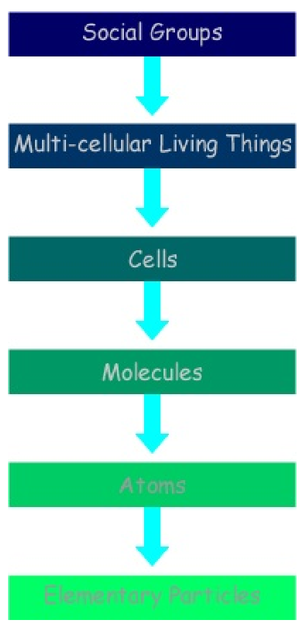
(1) The vocabulary of T2 contains terms not in the vocabulary of T1.
(2) Any observational data explainable by T2 are explainable by T1.

(3) T1 is at least as well systematized as T2. (T1 is normally more complicated than T2; but this is allowable, because the reducing theory normally explains more than the reduced theory. However, the "ratio," so to speak, of simplicity to explanatory power should be at least as great in the case of the reducing theory as in the case of the reduced theory.) (P&O, p.409)

Hierarchical Structure of the Unity of Science

P&O propose that the Unity of Science (in both the trend sense and ideal state sense) must resolve itself into hierarchical levels based upon (a) the units of analysis scientists with a given science employ (b) and the transitive, asymmetric inclusion relation between levels dictated by the transitive, asymmetric, decompositionality relations between units of analysis at each level.

Diagram of Hierarchical Levels in a Unified Science



Modified from P&O, p.409