Hanson gave us some insight on how scientific theories can be categorized, but how do these actually explain things?

LAW DRIVEN scientific explanation

Hempel, in *Aspects of Scientific Explanation*, argues they draw their EXPLANATORY POWER from the scientific LAWS upon which they are built. In this sense, THEORIES are just SYSTEMS OF LAWS and in limiting what is allowed to happen in nature, they explain things.

* There are two kinds of statements: INITIAL/ CONTINGENT CONDITIONS (e.g. there is a thermometer

Together they make sense of what we see. E.g. the temperature rise affects first the glass, which expands and the Hg inside drops; afterwards the Hg expands even more than glass and grows accordingly

made of glass and filled with Hg, which is dunk into hot water,

shows a rapid decrease in temperature and then a swift rise)

GENERAL STATEMENTS (e.g. thermic expansion happens at

different degrees according to the density and the material of

the substance)

* LAWS are UNIVERSAL STATEMENTS asserting a UNIFORM CONNECTION between EMPIRICAL PHENOMENA (mind that Hempel thought logic embraced everything in the realm of knowledge, so there cannot be exceptions to genuine LAWS, representable through mathematics)
* Every time something happens, we can refer to a RELEVANT general LAW, as whenever we have a LAW, we have a particular EXPLANATION

L1, L2, …, Ln -> LAWS (at least one)

EXPLANANS sentences

This is a kind of DEDUCTIVE-NORMOLOGICAL MODEL OF EXPLANATION

C1, C2, …, Cn -> CONTINGENT CONDITIONS

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EXPLANANDUM sentences

E1 -> EXPLANATION

* If the LAW is confirmed/ verified/ not falsified it would lead deductively to a correct EXPLANATION
* Phenomena are thus instances of general LAWS
* Hempel isn’t interested in knowing how a LAW can be considered true, only in defining logically what an EXPLANATION is
* To ensure we can distinguish between accidental universality and the generality of a scientific LAW, Hempel devised a TEST OF PROPER UNIVERSALITY (or OF COUNTERFACTUALS, i.e. not about actual state of affairs but of what would have been the case even if the antecedent wouldn’t have occurred)
* All gases expand when heated under constant pressure -> if the oxygen in this cylinder were heated

under constant pressure, it would

expand. This is logically acceptable

* All apples in this basket are red -> if an apple was placed in the basket, it would be red. This is

clearly not logically acceptable!

* A genuine scientific LAW can withstand this test, since this shows that they can be projected unto cases not yet observed
* Another problem Hempel had to deal with is that of the truth of the LAWS
* He was aware they were only at most approximately true or CETERIS PARIBUS true (= all things being equal; i.e. nothing interferes with what is described by the law)
* LAWS work under very well selected circumstances
* According to Cartwright, every LAW is CETERIS PARIBUS; they do not describe nature in practice, but instead a simplified version of it, in which we force it to work how we desire and idealize it all (through lab experiments, for instance)
* LAWS deal with idealized, not real version of nature
* We return to the old Humean question: how do we infer UNIFORMITY stated in the laws?

Hempel says we infer it through a LAW of BROADER SCOPE, and this can be done multiple times at once, with the same kind of logical inference

* DATA/ DESCRIPTIONS --> account of individual facts

Explainable through

EMPIRICAL LAWS --> non-accidental correlations between observable data (mainly through

specific instruments

1st ORDER THEORIES --> assumptions made using comprehensive LAWS

2nd ORDER THEORIES. --> even greater systems

And so on, considering that the kind of inference between each level is the same

* E.g. if Newton’s gravitational law is considered true, we can explain empirical DATA
* There are two main problems with this:
* EXPLANATION reduced to fitting phenomena into regularities, otherwise there is none
* FITTING PHENOMENA is based on LAWS, but the solution given by Hempel is dangerously akin to an ad infinitum regression (e.g. to answer to why different metals melt at different temperature, a scientist might bring out atomic structure, binds, etc., and the EXPLANANS is not the LAW, but the existence of atoms for instance. In this case we are getting out of the model elaborated by Hempel, as we are postulating entities to explain what we experience)
* E.g. Tycho Brahe’s observations -> Kepler’s LAW of planetary motion (elliptical orbits with the Sun at one of the foci) explains Brahe -> Newton’s LAW of gravitation (every body is affected by the force of gravity) gives an explanation to Kepler
* We are not merely describing gravity, but also using it to uniformly connect variables in a way that successfully EXPLAINS them (but we end up postulating gravity’s existence)
* Alternative EXPLANATIONS could refer to postulating other ENTITIES
* We are inferring what happens in DATA or theories by means of other theories
* Often the ENTITIES we assume as true are unobservable, and in many cases ENTITIES of this kind proved to be false
* We are aware only of the logical structure of THEORIES as logical constructs; postulating entities makes us venture into the contents of such construct
* THEORIES = ontological maps; i.e. tell us how the world is like
* By postulating unobservable (in principle) ENTITIES we shape RISKY DEVICES out of our THEORIES, as by entrusting them there would always be the peril of letting them us go astray (in Cartwright’s words, they ‘lie’)
* SCIENTIFIC REALISM = there are convincing arguments to believe not only that THEORIES

speak the truth, but also that there is a world outside us waiting to

be explored

* SOCIAL CONSTRUCTIVISTS = theories lie, they postulate pure fiction and they do not

represent anything except a functional way to practice science