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Chapter 8

The Propositional Representation of Experience

0. Experience in small-e empiricism

Small-e empiricism is a scientific empiricism. That is, it is a version of empiricism that is adapted specifically to science. Formulating it requires an extensive revision of the notion of experience as it has commonly appeared historically in much of the writing in empiricism. This chapter and the three that follow seek to articulate this revised notion of experience. The revision is guided by a general principle:

We should choose a notion of experience in scientific empiricism that

• *only introduces philosophical problems peculiar to science; and*

• *conforms with how experience plays a role in scientific practice.*

To this end, three adaptations are developed in these chapters. In the present chapter, it will be argued that a scientific empiricism should not employ the cognitive notion of experience that has been routine in much writing in empiricism. For treatment of this cognitive notion requires accommodation of something whose import is to be suppressed in a scientific empiricism: the individual cognitive idiosyncrasies of different human observers. It is to be replaced by a propositional notion, for then we have a formulation of experience that can enter into relations of inductive support and participate in the public discourses of science.

The next Chapter 9 will argue that, through its use of increasingly sophisticated instrumentation, modern science has surpassed the restricted notion of experience as a human sensory act. It has been replaced by propositions describing processes that connect directly to the systems of interest in the world. This expansion preserves what has traditionally given experience its authority. It does not derive from anything special about human sense organs and mental processing. The authority derives from their mediation in a physical process that connects directly to the systems of interest in the world.

Chapters 10 and 11 will develop the conception of experience as a physical process that connects continuously with the system of interest. This conception replaces the traditional conception of experience as a distinct human sensory act or as a singular report of some observation or experimental outcome. This traditional conception has proven to be endlessly troublesome: it requires a division in the content of a science between the experiential and non-experiential. The traditional conception will be replaced by one that presumes no such division. Propositions associated with experience describe various stages of the experiential process. A stage may be closer or farther from experience according to its place in the continuous physical process. A sharp division between experiential and non-experiential propositions is not posited.

1. Introduction

At a broad level of description, two notions of experience appear in traditional accounts of empiricism. One is cognitive. Experience is associated with processes through which our sense organs induce mental states. The other notion is propositional. These are factual statements that are closely informed by our contact with the world, through observation and experimentation. As we saw in the earlier historical survey, through most of its history, different versions of empiricism have employed both cognitive and propositional notions of experience without too much concern over their fundamental differences. This is true of accounts of empiricism within traditional epistemology and also within philosophy of science.

This mingling of the two notions, I will argue in this chapter, has proven troublesome. Each requires different methods for their analysis and, as a result, each raises different questions and problems. Attempts to use both notions require a disentangling of these different problems and that greatly complicates the burden of analysis.

The version of empiricism developed here will escape these problems by restricting the notion of experience to the second propositional notion. It will be argued that this propositional notion is the one appropriate for understanding how empiricism is realized within science. To include the cognitive notion is to embroil empiricism in science in difficulties that are worthy of philosophical scrutiny but should be treated separately. Some have proven deeply intractable, while their resolution is of minor importance for a scientific empiricism. This restriction implements the clause in the principle above that the notion of experience should be one that "*only introduces philosophical problems peculiar to science.*"

Section 2 below will illustrate the propositional representation of experience in three works of importance in science: Newton's *Principia*, Mendel's experiments on plant hybrids and Hubble's analysis of recession of the nebulae. In each case we can see that experience enters in propositional form at the initiation of the analyses. Section 3 recalls the need to limit the notion of experience to the propositional. Section 4 specifies how the cognitive and propositional notions of experience differ in their relata, relations and associated methods. Subsequent sections review the problems confronting analysts who adopt the cognitive notion of experience. Research in psychology raises serious doubts about the reliability of introspection as a means of accessing accurately the properties of this form of experience (Section 5). The existing analyses of justification associated with the cognitive notion are commonly underdeveloped, relying mostly on everyday intuitions. They may sometimes extend in speculative ways beyond the existing literature in deductive and inductive inference (Section 6). The problems naturally arising with the cognitive notion, such as Cartesian doubt, are remote from those specific science (Section 7). Through the example of Penzias and Wilson's observation of the cosmic microwave background, Section 8 illustrates again how the problems peculiar to science are associated with the propositional notion of experience and not with the cognitive notion.

2. Experiences as Reported in Science: Newton, Mendel and Hubble

The experiences pertinent to scientific empiricism are propositions that convey the results of observation and experimentation. In their most familiar form, they are reports of such results appearing in the published scientific literature. They seek to present this content in a form that is independent of the vagaries of any of the individual scientists involved in the observations and experiments. Great efforts are made to purge them of subjective elements peculiar to the individual scientists. The goal is that their import can be understood equally well by all scientifically literature readers.

A few examples will illustrate what is surely a familiar idea. The immense volume and variety of such reports makes selection of a representative sample impractical. The reports of Newton on planetary motions, Mendel on the hybridization of peas and Hubble on the recession of nebulae have been chosen because of their ready accessibility, but the choice was otherwise arbitrary. They are, at least, central to physics, biology and astronomy and are sufficiently unremarkable as to remind us of the general character of such reports.

2.1 Newton's Phenomena

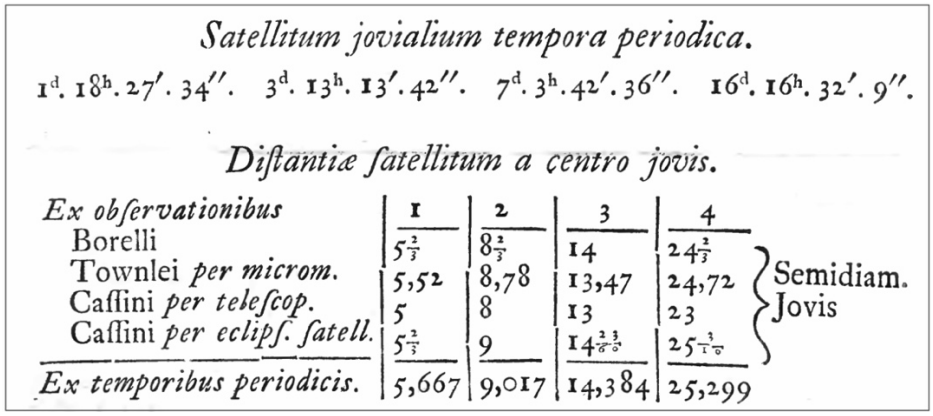
In his Preface to his monumental *Mathematical Principles of Natural Philosophy*, Isaac Newton (1934, Book I, p. xvii-xviii) gave a memorable and succinct summary of the totality of his project:

> … for the whole burden of philosophy seems to consist in this—from the phenomena of motions to investigate the forces of nature, and then from these forces to demonstrate the other phenomena…

Experience enters the project through the reports of phenomena. In Book III, his *System of the World*, Newton listed six phenomena that provided the observational basis of his recovery of the forces governing the planetary system. For example, the first concerns the moons of Jupiter (p. 401):

> PHENOMENON I
>
> The circumjovial planets, by radii drawn to Jupiter's center, describe areas proportional to the times of description; and that their periodic times, the fixed stars being at rest, are as the 3/2th power of their distances from the centre.

The report was immediately followed by a brief recounting of the basis of this phenomenon in "[What] we know from observation." He then gave, in a list and tabular form (Figure 2), the observations of the periods and distances of the moons from Jupiter's center that were summarized in this phenomenon. They were prefaced with the remark that "… all astronomers agree…" on the summary given in Phenomenon I. It was, Newton was assuring us, a phenomenon purged of any idiosyncrasies of an individual astronomer.



Satellitum jovialium tempora periodica.

1d. 18h. 27′. 34″. 3d. 13h. 13′. 42″. 7d. 3h. 42′. 36″. 16d. 16h. 32′. 9″.

Distantiæ satellitum a centro jovis.

Ex observationibus	1	2	3	4	
Borelli	$5\frac{2}{3}$	$8\frac{2}{3}$	14	$24\frac{2}{3}$	Semidiam. Jovis
Townlei *per microm.*	5,52	8,78	13,47	24,72	
Cassini *per telescop.*	5	8	13	23	
Cassini *per eclipss. satell.*	$5\frac{2}{3}$	9	$14\frac{23}{60}$	$25\frac{3}{10}$	
Ex temporibus periodicis.	5,667	9,017	14,384	25,299	

Figure 2. Newton's Report of Observations of the Moons of Jupiter[1]

2.2 Mendel's Peas

Gregor Mendel (1865) reported his famous experiment on the hybridization of pea plants in his "Experiments on Plant Hybrids." His goal was to determine the frequencies of dominant and recessive traits in new generations when pea plants are hybridized. The details of these experiments are too well known to need repetition here. Our concern is the level of detail in his reports of his experiences with the experimental outcomes.

The characteristics tracked were given verbal descriptions sufficient for others to identify them unambiguously. The ripe seeds are "either spherical or somewhat rounded, and the depressions, if any, occur on the surface, and are only shallow; or they are irregularly angular and deeply wrinkled" and "The albumen of the ripe seeds is pale yellow, bright yellow, or orange colored; or it possesses a more or less intensive green colour." (Mendel, p. 8/p. 408). Ambiguity is further controlled by reporting results in numerical form. The first two experiments on the first generation of hybrids involved over 500 peas plants. Mendel (1965, p. 12/p. 410) reported the overall results with famous ration of 3:1 of dominant to recessive characteristics:

> *First experiment:* Shape of the seeds. From 253 hybrids, 7324 seeds were obtained in the second experimental year. Of these seeds 5474 were round or somewhat rounded, and 1850 were angular wrinkled. The resulting ratio is 2.96:1.
> *Second experiment:* Colour of the albumen. A total of 258 plants produced 8023 seeds, 6022 yellow and 2001 green; the former relate to the latter in the ratio 3.01:1.

[1] From the Latin edition of 1726.

Since these two experiments involved over 500 plants, Mendel found it impractical to give a complete numerical accounting of his results. He could, however, give readers a flavor of the results by reporting the characteristics recovered from the first ten plants in each experiment through a tabulation of their results, shown in Figure 3.[2] It was followed by a brief recitation of the most extreme distributions of the seed characteristics in individual plants.

1. Versuch.			2. Versuch.	
Gestalt der Samen.			Färbung des Albumens.	
Pflanze	rund	kantig	gelb	grün
1	45	12	25	11
2	27	8	32	7
3	24	7	14	5
4	19	10	70	27
5	32	11	24	13
6	26	6	20	6
7	88	24	32	13
8	22	10	44	9
9	28	6	50	14
10	25	7	44	18

Figure 2. First ten plants of Mendel's first two experiments

The word "experience" (*Erfahrung*) appears only three times in the text. It has a liberal import. For example, Mendel (p. 41/p. 420) reports "…the universally confirmed experience that it is unimportant for the form of the hybrid which of the original forms was the seed or the pollen plant."

2.3 Hubble's Nebulae

In his 1929 "A Relation between Distance and Radial Velocity among Extra-Galactic Nebulae," Edwin Hubble reported what become the foundational result of modern cosmology. The extra-galactic nebulae—or "galaxies" as we now call them—recede from us with a velocity whose mean is a linear function of the distance from us. Experience entered the report in the form of a tabulation of the velocities of and distances to the 46 nebulae of Hubble's analysis. Once again, subjectivity is suppressed by the reporting of numbers that, supposedly, could be

[2] Mendel (1965, p. 12) Captions: "1. Experiment, shape of the seeds, plant, round, angular; 2. Experiment, color of the albumen, yellow, green"

recovered by any astronomer competent in the appropriate observational techniques. Figure 4 shows his tabulation for these data in the case of the 24 nebulae for which Hubble felt that the distances given were known more securely.

TABLE 1

NEBULAE WHOSE DISTANCES HAVE BEEN ESTIMATED FROM STARS INVOLVED OR FROM MEAN LUMINOSITIES IN A CLUSTER

OBJECT	m_s	r	v	m_t	M_t
S. Mag.	..	0.032	+ 170	1.5	−16.0
L. Mag.	..	0.034	+ 290	0.5	17.2
N. G. C. 6822	..	0.214	− 130	9.0	12.7
598	..	0.263	− 70	7.0	15.1
221	..	0.275	− 185	8.8	13.4
224	..	0.275	− 220	5.0	17.2
5457	17.0	0.45	+ 200	9.9	13.3
4736	17.3	0.5	+ 290	8.4	15.1
5194	17.3	0.5	+ 270	7.4	16.1
4449	17.8	0.63	+ 200	9.5	14.5
4214	18.3	0.8	+ 300	11.3	13.2
3031	18.5	0.9	− 30	8.3	16.4
3627	18.5	0.9	+ 650	9.1	15.7
4826	18.5	0.9	+ 150	9.0	15.7
5236	18.5	0.9	+ 500	10.4	14.4
1068	18.7	1.0	+ 920	9.1	15.9
5055	19.0	1.1	+ 450	9.6	15.6
7331	19.0	1.1	+ 500	10.4	14.8
4258	19.5	1.4	+ 500	8.7	17.0
4151	20.0	1.7	+ 960	12.0	14.2
4382	..	2.0	+ 500	10.0	16.5
4472	..	2.0	+ 850	8.8	17.7
4486	..	2.0	+ 800	9.7	16.8
4649	..	2.0	+1090	9.5	17.0
Mean					−15.5

m_s = photographic magnitude of brightest stars involved.
r = distance in units of 10^6 parsecs. The first two are Shapley's values.
v = measured velocities in km./sec. N. G. C. 6822, 221, 224 and 5457 are recent determinations by Humason.
m_t = Holetschek's visual magnitude as corrected by Hopmann. The first three objects were not measured by Holetschek, and the values of m_t represent estimates by the author based upon such data as are available.
M_t = total visual absolute magnitude computed from m_t and r.

Figure 4. Hubble's report of velocities of and distances to 24 nebulae[3]

The bare recitation of numbers in this chart belies the immense complexity of the analyses of decades preceding that enabled the determination of these distances and velocities. A

[3] In 2025, Hubble's 1929 paper entered the public domain in the US since it was published more that 95 years ago.

recitation of those analyses would be superfluous for the small community of expert astronomers for whom Hubble wrote. Rather Hubble's exposition was more concerned to recount the labyrinthine maneuvers needed to secure distance measurements for the remaining 22 nebulae.[4]

Hubble's (1929) text does not contain the word "experience." However, it is comfortable talking of what is observed. The nebula N.G.C. 404 has an "observed velocity … so small…" (p. 172); and, more generally, the overall result is reported as obtaining between "distances and observed velocities." (p. 173) Hubble is prudent in not describing the distances to the nebulae in his data as "observed" since determining the distances proved to be especially troublesome for 22 of 46 nebulae. The velocities attributed to these nebulae were recovered from the measured red shift in their light. It was a procedure that Hubble found secure enough to elevate with the label "observed."[5]

3. Why Cognitive Experience is Excluded from a Scientific Empiricism

The propositional notion of experience just described differs from the cognitive notion of experience. We saw in the earlier historical survey that this cognitive notion has been the one used widely throughout the history of empiricism and epistemology as early as the seventeenth century. Is such a stark reconception advisable? Might we do well to proceed with both notions? After all, experience is ultimately a cognitive event. In the simplest versions, our sense organs interact with the world and produce the mental states we identify as experiential. Traditionally,[6] the propositional notion of experience is ultimately dependent on this cognitive notion. Newton's

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[4] For a detailed examination of the resulting, complicated relations of inductive support in Hubble's paper, see Norton (2024, Ch. 7)

[5] Even this more secure case faced problems. The velocities "*v*" reported in the table do not correct for the motion of our planetary system in Milky Way. Hubble subtracted his best estimate of this velocity from that of the nebulae before constructing a graphical plot (p. 172) that displays on average a linear relationship between velocity and distance.

[6] This has been true for much of the history of science. The next chapter will argue that sophisticated scientific instrumentation has displace human sense organs and human cognitive states in process that connect with objects of interest and, I will argue, now serve the role of experience.

phenomena were recovered from the optical observations of astronomers, such as those Newton listed in Figure 2: Borelli, Townlei and Cassini. Mendel's classification of peas as wrinkled or otherwise depended on Mendel actually looking at the peas and making the appropriate judgment.

My answer is that prudence dictates that a scientific empiricism—that is one that is well adapted to the problems peculiar to the sciences—should restrict itself to the propositional notion. The two notions differ. As a result, the analyses appropriate to each differ in the concepts and methods they use. These concepts and methods in turn give rise to the problems addressed in the literatures associated with each mode of analysis. We will see that, because of these differences in concepts and methods, the problems that arise in a scientific empiricism are distinct from those that arise in an empiricism based on the cognitive notion of experience. This is not to discount the cognitive notion. It raises deep and interesting problems in epistemology that deserve the most serious attention. These problems, however, are not peculiar to science. They are of a general type that extends well beyond the specific empirical concerns of a science. Accordingly, I will proceed with the principle stated in the introduction, that we should proceed with a notion of experience that "*only introduces philosophical problems peculiar to science.*"

The sections to follow will recount the many differences in the concepts, methods and problems associated with the two conceptions of experience; and they will indicate why a prudent scientific empiricism should start where the cognitive notion of experience transitions into the propositional notion.[7]

4. Cognitive and Propositional Experience

The differences between these two notions of experience can be summarized if we consider the relata and relations associated with the two forms of experience. To begin, if we restrict ourselves to propositional experience, then the subsequent analysis can continue with propositions:

Propositional analysis

Relata: Propositions drawn from experience and those propositions supported by them.

[7] The further question of whether a serviceable scientific empiricism *can* be formulated in this manner in the subject of the following chapters.

Relations: Inductive and deductive relations of support among propositions, as specified by the applicable logic.

Methods: Deductive and inductive logics.

An analysis of this type is familiar and relatively unproblematic. There is an extensive literature on deductive and inductive logic, including my own contributions in Norton (2021, 2024). Although the nature and foundation of inductive inference remains an open topic of discussion in philosophy of science, the difficulty is not a lack of well-developed accounts, but a surfeit of such competing accounts.

If our empiricism employs the cognitive notion of experience, then the methods appropriate to the analysis are less straightforward. A comparable delineation is:

Cognitive analysis

Relata: cognitive states, including those responding to stimuli of the senses and associated ideas and conceptions.

Relations: Mental processes, conscious and unconscious, connecting these cognitive states.

Methods: Introspection and experimental psychology.

This form of analysis is most common in modern writings in epistemology, whether they be empiricist or otherwise. In that literature, the concepts and methods of this analysis are less well developed. Although their substance concerns empirically testable claims about our mental lives, this literature largely proceeds with introspection and armchair theorizing. This general approach has been criticized sharply by new field of "experimental philosophy.[8]"

5. Access to Cognitive States and Processes

In almost all traditional work in empiricism, it is supposed that we have direct access to cognitive states and mental processes simply by introspection and, perhaps, the reports of introspection by others. This access proves to be less reliable than these earlier workers supposed. Modern psychology offers a more systematic, empirically grounded alternative. When Hobbes, Locke and Hume wrote, there was no independent science of psychology. Their efforts were as much a contribution to philosophy and epistemology as they were early steps in the development of the science of psychology. That era is long past. We now have psychology as a

[8] See Knobe and Nichols (2017) for an introduction to experimental philosophy.

specialty within science. It seeks to learn about mental processes by empirical investigations. In so far as cognitive analysis seeks factual claims about mental processes, the project has now been subsumed by psychology.

This fact is the basis of Quine's proposal for a "naturalized epistemology." He wrote (1969, pp. 82-83)

> Epistemology, or something like it, simply falls into place as a chapter of psychology and hence of natural science. It studies a natural phenomenon, viz., a physical human subject. This human subject is accorded a certain experimentally controlled input–certain patterns of irradiation in assorted frequencies, for instance–and in the fullness of time the subject delivers as output a description of the three-dimensional external world and its history.

The proposal may seem appealing initially to a scientific empiricism. Here is a proposal to use empirical science itself to analyze the cognitive states and mental processes associated with cognitive analysis.

Quine's proposal has proven controversial; and with good reason. A telling criticism, made by, for example Kim (1988), is that a purely descriptive psychology cannot supply the normativity so central to epistemology. This point is uncontestable. That our mental processes take us from one idea to another is insufficient to assure us that the first justifies the second without some external standard for justification. Such a standard is absent if the epistemology is completely naturalized, that is, fully given over to the empirically determined description of which mental processes occur and which do not.

There is a second, more serious difficulty. It is not so much a problem for a naturalized epistemology, as a problem revealed by naturalized epistemology. When the cognitive analysis is based on introspection, we presume that we automatically have a reasonable grasp on the character of our cognitive states and on the mental processes that connect them. The empirical research of psychologists routinely reports results contradicting this presumption of armchair psychologists. For example, the field of behavioral economics is based on the empirical finding that our behavior in making economic choices is less rational than we perceive it to be. An early contribution to this literature was Kahneman and Tversky's (1979) "prospect theory," which explored systematic deviations from default suppositions about what constitutes rational decision making. For example, they found that decisions differ according to whether the possibilities in

the same choice situation are formulated in terms of losses or gains. The field of "experimental philosophy" works in the same tradition. It tests empirically the extent of acceptance of intuitions assumed by default in philosophy to be widely shared. Machery et al. (2004), for example, found that semantic intuitions guiding philosophical theories of reference vary with culture.

Results within this general literature impinge directly on the introspective methods commonly associated with the cognitive notion of experience. They challenge both our assumption of the veracity of our cognitive experiences and our perceptions of the rationality of our mental process.

A significant example of a challenge to the veracity of our experiences arises in empirical tests of the reliability of eyewitness testimony. Juries in trials are inclined to give great weight to eyewitness testimony. In doing so, they harbor the armchair view that testimony from eyewitnesses is akin to the replaying of a tape recording of the pertinent events. Research in psychology, however, shows that memory recall is less akin to the mechanical reproduction of experience and more akin to a reassembly of scattered fragments. This reassembly can be tainted by many circumstances and even include entirely spurious parts. The result, unfortunately, has been the false conviction of innocent subjects. This has been a persistent problem even in significant criminal cases, in which witnesses seek to report as accurately as they can.[9] These sorts of results are troublesome for foundationalists in epistemology who take the simplest cases of experience to be self-justifying.

The recognition of so-called "confirmation bias" challenges our perception of the extent to which our beliefs are justified by our default mental processes. The bias manifests in many forms. The commonality is that we tend to overestimate evidence that supports beliefs we favor and discount evidence that does not. In a review of the bias, Nickelson (1998, p.175, his emphasis) remarks:

> If one were to attempt to identify a single problematic aspect of human reasoning that deserves attention above all others, the *confirmation bias* would have to be among the candidates for consideration. Many have written about this bias, and it appears to be sufficiently strong and pervasive that one is led to wonder whether the

[9] For a review, see Howe and Knott (2015).

> bias, by itself, might account for a significant fraction of the disputes, altercations, and misunderstandings that occur among individuals, groups, and nations.

The presence of this bias challenges the reliability of informal judgements by someone that their beliefs are well founded.

These sorts of empirical results present formidable and interesting problems for epistemology. How are we to arrive at a secure characterization of our cognitive states and processes? If a scientific empiricism begins with the propositional notion of experience, these problems do not arise. Propositional expressions of experience, such as illustrated in Section 2 above and reported in the literature, become the starting point of logical analysis. There is little ambiguity in their content; and pertinent processes that connect them are the logical relations sanctioned by deductive and inductive logics. A particular scientist may mistake the true import of evidence because of that scientist's confirmation bias. That failure is a part of the psychology of the scientist. What matters for a scientific empiricism is the strength of support provided by the applicable logic.

A complete isolation of scientific empiricism from the problems of cognitive analysis is not possible. There is always the possibility that some propositional expression is in turn founded upon some aberrant or anomalous cognitive processing. Such cases do arise and these examples will be discussed further in Chapter 10. An example of aberrations in a simple experience is the "personal equation" in astronomy. Systematic differences among observers in the timing of astronomical transits were corrected by attaching a correction factor, the personal equation, to each observer. The persistence of reports of flying saucers, alien spaceships and the like results from misinterpretations of ambiguous aerial phenomena. The misinterpretation arise through a form of confirmation bias in which observers are too ready to overinterpret these ambiguous phenomena in terms of an extraterrestrial hypothesis that happens to be readily at hand. These sorts of cases are not a locus of major problems in scientific empiricism. They are readily treated on a case by case basis by the psychological analysis.

6. Justification in Cognitive Analysis

A primary burden of an empiricism is to establish that experience justifies our picture of the world. Thus, the notion of justification is central to any empiricism. This burden has proven to be troublesome for an analysis that employs a cognitive notion of experience. This analysis

tracks how mental processes connect experience as a cognitive state to other mental states and then also the processes that connect these mental states to other mental states. The central question is how well these processes justify the content of the mental states in which they terminate. An answer requires a well-articulated account of justification. However, the accounts of justification in this literature are underdeveloped and scattered. The reason for this scatter lies, at least in part, in the fact that the mental processes serve in two roles in the analysis:

> *Descriptive*: The description of mental processes in the analysis must conform with our actual mental processes, that is, how we actually think.
>
> *Normative:* The mental processes described must also serve in a justificatory role. That is, we must be able to identify among these mental processes those that lead us or tend to lead us from veridical sense experience to veridical ideas.

We have already seen in the last section that results in empirical psychology show that the two cannot be easily combined. For we are often mistaken in accepting that some mental process has successfully justified a belief. It is essential that we distinguish cases of mental processes that are genuinely confirmatory from those that are not. That distinction requires an independent and well-developed account of justification.

The literature in epistemology is so large as to escape tractable surveys and summaries. The best I can offer is a fairly small sampling of the epistemology literature. It already indicates the underdeveloped character of accounts of justification. This section will address the extent to which a systematic account of justification has been developed.

At the most destructive extreme are accounts that simply deny that our natural mental processes can realize inductive relations of justification. We saw in Chapter 2 the most famous example. David Hume argued that, at best, our accounts can satisfy the first descriptive requirement, but not the second normative requirement. That is, he accepts that our "mind is carried by habit" from the idea of one event to that of a second. That provides no justification for the claim that the first event, as a general matter, brings about or causes the second. Van Fraassen's constructive empiricism is a recent version of inductive skepticism. We saw in Chapter 4 that van Fraassen's later writing made his skepticism clear. "Inductive logic is a make-believe theory…" he wrote.

The mainstream of present writing in epistemology is properly undeterred by such skepticism and routinely accepts that beliefs can justify others. Since this literature is so large, it

is with some trepidation[10] that I report my impression that virtually all the analysis proceeds without a well-developed account of justification. *This* is said to justify *that* in the everyday sense of a philosophically untutored lay person. This is seen fairly easily in internalist epistemological writing, in which the basis of a claimed justification is required to be accessible to the consciousness of the cognizer. Edmund Gettier's influential article challenges the notion of knowledge as justified, true belief. He conception of justification in his examples is quite prosaic. One is this (1963, p. 122):

> Let us suppose that Smith has strong evidence for the following proposition:
> (f) Jones owns a Ford.
> Smith's evidence might be that Jones has at all times in the past within Smith's memory owned a car, and always a Ford, and that Jones has just offered Smith a ride while driving a Ford.

The basis of the justification is clear enough as far as ordinary, everyday thinking goes. The example falls well short of what a precise logical analysis would require. It leaves tacit background facts that would otherwise be essential to displaying the warrant for the inference. Whether some definite rule of inductive or deductive inference has been invoked is also left unsaid.

These sorts of prosaic examples are routine. Here is another, haphazardly chosen example. In his defense of internalist reliabilism, Steup(2004) gives an example that begins (p. 407):

> Consider my 1988 Honda Accord, still in my possession and put to daily use. It's been a remarkably reliable car. My evidence for attributing reliability to it is this: I remember that is has rarely let me down. Put differently, I remember that it has a good track record. Likewise, I remember that my perceptual faculties have rarely let me down. …

[10] Here I was consoled to find Fumerton (2002) in a synoptic article on theories of justification in epistemology writing (p. 204) "The task of explaining and evaluating theories of justification, however, is daunting."

An externalist epistemology denies that the basis of justification is accessible to consciousness. A reliabilist externalist epistemology locates the justification of a belief in the reliability of the process that gave rise to it. Here is Goldman's (1979, p.10) synopsis:

> My positive proposal, then, is this. The justificational status of a belief is a function of the reliability of the process or processes that cause it, where (as a first approximation) reliability consists in the tendency of a process to produce beliefs that are true rather than false.

The illustrations of the proposal once again depend on familiarities of everyday life, as opposed to a well-developed account of justification. For example (p. 10, his emphasis):

> Visual beliefs formed from brief and hasty scanning, or where the perceptual object is a long distance off, tend to be wrong more often than visual beliefs formed from detailed and leisurely scanning, or where the object is in reasonable proximity. In short, the visual processes in the former category are less reliable than those in the latter category. A similar point holds for memory beliefs. A belief that results from a hazy and indistinct memory impression is counted as less justified than a belief that arises from a distinct memory impression, and our inclination to classify those beliefs as "*knowledge*" varies in the same way.

A serious difficulty for this assessment is provided by the case discussed above of the unreliability of eyewitness testimony.

Sometimes, though not commonly, general accounts of inductive inference in the larger literature are drawn on. The core notion for coherentist epistemology is the mutual coherence of a body of beliefs. That coherence arises through the mutual support of the beliefs. Bonjour's (1985, pp. 94-101) conditions for a set of beliefs to be coherent includes that they are logically and probabilistically consistent and explanatory. These conditions reflect two of the major accounts of inductive inference at the time of Bonjour's writing: a Bayesian probabilistic account and an abductive, explanatory account.[11]

Epistemologists have also recognized that their notions of justification extend beyond that of the familiar logical notions of deduction and induction. Chisolm (1989) defends a notion of "internal justification" summarized as (p. 7, his emphasis):

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[11] For more discussion of coherentist notions of support, see Norton (2024, §4.2).

> If a person S is *internally justified* in believing a certain thing, then this may be something he can know just by reflecting upon his own state of mind.

Chapter 2 of Chisolm (1989) provides an elaboration and defense of the notion that includes listing many plausible properties for it. For example, the first axiom "A1" is (p. 12):

> If A is more justified than B for S, then B is not more justified than A for S.

While properties such as these mimic those recoverable in an inductive logic, Chisolm's notion differs from that of an inductive logic. That this is so follows from the fact that internal justification is a monadic property (for person S) of a proposition. In inductive logic, justification is minimally a dyadic relation between the evidence and the proposition supported. Chisolm makes quite clear that his notion of justification goes beyond that of inductive logic. He wrote (p. 10):

> We must take care to distinguish this fundamental epistemic sense of "probable" from the sense that that expression has in statistics and in inductive logic. In those disciplines "probable" is defined in terms of frequency of occurrence—sometimes in terms of "the limit of relative frequency in the long run." But the epistemic concept of probability, although it is closely connected with the concept of frequency, is a concept of a very different sort. (We consider this topic in more detail in Chapter 6).

The elaboration in Chapter 6 directly addresses a dyadic concept of inductive support. The relation considered is (p. 50)

> *e* tends to make *h* evident = Df *e* is necessarily such that it tends to provide *h* with strong inductive support.

The first of two difficulties Chisolm reports is, in effect, that this is a binary relation on propositions (p. 50, his emphasis):

> Our consideration of the evidence of the senses makes it clear that this type of definition does not include everything it should include. My present sense-experiences make it evident to me that I now see a sheep, but these experiences, as we saw in discussing the view of Sextus Empiricus, cannot be said to provide *inductive* support for the proposition that I see a sheep. So, too, for those present facts—if there are any—that tend to make it evident that it snowed here last night.

That justification can be a monadic property of a belief has a continuing presence in epistemology. Audi (2019) has defended the view that for some propositions, merely understanding them can be sufficient justification for belief in them.[12]

This notion of self-evident justification has a central role in foundationalism in halting what is otherwise portrayed as a fatal infinite regress. It is halted by foundational beliefs that require no further justification. Here is Fumerton's (2010) encapsulation of this argument:

> If the only way to justify a belief in some proposition is to justifiably infer it from some other proposition, and the principle of inferential justification is true, then to justifiably believe any proposition one would need to complete not one but infinitely many, infinitely long chains of reasoning. This we cannot do. The solution, the foundationalist argues, is to recognize what common sense itself dictates – we have justification for believing some truths where that justification does not consist in the having of other different justified beliefs.

Of course, the enduring problem for this monadic notion is the familiar problem of Cartesian doubt, to be discussed in the next section. We feel as justified in believing a banal proposition derived properly from sense experience as does a dreamer in the throes of a vivid dream and a madman in the grip of a fearsome hallucination. For further discussion, see Fumerton (2014).

The difficulties of reconciling the descriptive and normative requirements within cognitive analysis are formidable and worthy of serious attention. Their resolution would likely provide only marginal gains, if any, for the sorts of problems specific to a scientific empiricism. (This lack is illustrated in some cases in the next sections.) Thus, it is prudent for a scientific empiricism to avoid the complications of this cognitive analysis. Once a propositional notion of experience is adopted, relations of justification can be specified by the applicable inductive and deductive logics. All that matters to scientific empiricism is the normative aspect, that is, the strength of the justification supplied.

We could ask the descriptive question: are these relations identified in a scientific empiricism implemented by the reasoning of the scientists in each specific case? The answers are

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[12] More precisely, the first sentence of Audi's abstract is "Self-evidence is plausibly taken to be a status that marks propositions as capable of being justifiedly believed (and known) on the basis of understanding them."

of great interest as a matter of history. However, unlike the case of the cognitive analysis, the scientists' actual reasoning is not the primary object of analysis. A scientific empiricism can give an account of scientific knowledge that omits all mention of the specific scientists whose reasoning did (or did not) realize the justificatory relations. Such an account is possible, but it would be tedious and lifeless for readers.

7. Problems of Cognitive Experience

The concepts and methods of cognitive analysis in turn have dictated the sorts of problems that occupy a prominent place in modern epistemology. These problems are, generally, unimportant to a scientific epistemology, as long as it is concerned with empirical problems peculiar to the science. This section reviews a few of these problems in epistemology.

In the last section, we saw the problem of selecting between an internalist and an externalist epistemology. Is the basis for the justification accessible to the cognizer (internalism)? Or it is inaccessible to the cognizer (externalism), but perhaps derived from the reliability of the mental processes connecting our mental states (reliabilist externalism)? This problem does not arise in a scientific empiricism as formulated in this text. Whether some proposition justifies some other proposition is a matter of the applicable logic. The fact of justification is independent of the mental states of scientists. Of course, we can hope that scientists are explicitly aware of the presence, absence and strength of justifications. That awareness has no definitional role in the logics.

A second problem of epistemology concerns foundationalism and was also sketched in the last section. Must we accept that, as we trace back chains of justification, that they terminate in experiences that are self-justifying? The question does not arise in the scientific empiricism of this text. We shall see in a subsequent chapter that it employs a relational notion of experience: *this* proposition can be said to closer in some process to the object of experience than *that*. There is no primitive conception of experience that we might ask to be self-justifying. Rather, as the chains of justification are traced back closer to experience, they will eventually transition into the cognitive realm. Or at least has been so until the modern era of sophisticated scientific instrumentation. A scientific empiricist can then hand over the problem of further analysis to an epistemologist who specializes in such problems.

The most prominent problem associated with cognitive experience is the venerable challenge of Cartesian skepticism. What assures us that our cognitive experiences are veridical? That is, are they informing us truly of an external world? Can we distinguish, René Descartes asked in his first meditation (1641), veridical cognitive experience from vivid dreams and delusions? How do we know, Descartes continued, that an all-powerful God is not deceiving us? Matters would then be so set up that there is no earth and no heavens, contrary to how things appear to us.

A familiar, modern version of this age-old problem is the brain-in-a-vat thought experiment. What if an evil scientist has taken our brains and kept them alive in vats of nutrients, while a supercomputer feeds our nerve endings electrical stimuli that perfectly simulate our familiar world? How could we know that the resulting cognitive experiences are all delusory? This is the most extreme version of many milder forms of the problem. If I sense green, can I be assured that I am seeing grass? Or if I sense red, can I be assured that I am seeing a red brick wall?

The deep intractability of the problem is shown by the fact that, since the time of Descartes, each generation has sought to solve the problem afresh. Putnam (1981), who gave a popular version of the brains in a vat thought experiment, argued that the scenario described is self-refuting. Gupta (2006) argued that we can, after all, make a connection from cognitive experience to know if we draw on a novel tool, the logic of interdependence.[13]

[13] My response is that we can only work with the inductive import of our experiences; and they overwhelmingly support the banality that the world is pretty much the way we think it is. That we can concoct fanciful stories in which matters are otherwise is no reason to discount the import of the evidence of our senses. We have ample evidence that water slakes thirst, fire burns and bread nourishes. We have no evidence at all for the specifics of the fanciful scenarios. Who is the evil scientist? Where is the vat? Is the science of vat nutrition and perfect computer simulation of stimuli possible? The vat world scenario is merely a logical possibility without evidential support and can surely only trouble someone who demands absolute certainty in their judgments. If that is what supports Cartesian skepticism, it is another casualty of the demand for infallibility.

8. Problems of Scientific Empiricism

An example illustrates how far these concerns are from the major issues in a scientific empiricism. In 1964 and 1965, Arno Penzias and Robert Wilson detected an unexpected excess of electromagnetic radiation of at a frequency of 4080 Mc/s in their horn antenna at Bell Laboratories in New Jersey. The proposition expressing the pertinent experience was reported in Penzias and Wilson (1965) as:

> Measurements of the effective zenith noise temperature of the 20-foot horn-reflector antenna … at the Crawford Hill Laboratory, Holmdel, New Jersey, at 4080Mc/s have yielded a value about 3.5°K higher than expected. This excess temperature is, within the limits of our observations, isotropic, unpolarized, and free from seasonal variations (July, 1964 - April, 1965).

This excess had no discernible terrestrial origin. It was posited to be cosmic in origin and eventually identified as just one component of the full spectrum of thermal cosmic background radiation of 2.7K. This background was in turn determined to be the residue of the cosmological big bang some ten billion years ago.

What is a pressing problem for scientific empiricism is to determine the accuracy of the measurement and, crucially, the extent to which it does provide support for a cosmic big bang some ten billion years ago.[14]

What is not a pressing problem for scientific empiricism is whether the signal detected was supplied to Penzias and Wilson by a deceiving demon; or whether they were unwittingly brains in vats being fed stimuli that simulate their arduous work with the antenna. More prosaically, a scientific empiricism should feel no compulsion to argue that Penzias and Wilson make a self-justifying attribution, when they attribute the grey patch they sense to the walls of their antenna.

What is a matter of central concern to scientific empiricism is just how well Penzias and Wilson can establish by the display of evidence and explicit argumentation in their published

[14] Establishing that Penzias and Wilson had detected the afterglow of the big bang was not straightforward and was only settled after several decades. For a recounting of this episode, see Norton (2021, §9.8).

paper that they have detected radiation with an extraterrestrial source and that it is "isotropic, unpolarized, and free from seasonal variations."

What is not a matter of central concern is whether Penzias and Wilson's natural mental processes lead them to a belief that the radiation is isotropic, unpolarized, and free from seasonal variations; or whether they are aware of the justificatory force of such processes; or that that justificatory force within their mental processes is inaccessible to them.

What is an important part of the problem for scientific empiricism is to determine whether they were mistaken in some element of their observations or the inferences made from them. Perhaps the signal they detected had a terrestrial source after all, but one they had overlooked. Perhaps, if they had detected a cosmic background radiation, it might not be support for an ancient, cosmological, big bang but merely for an eternally enduring, cold thermal cosmic environment. These are delicate matters of inductive inference that took decades to resolve.

What is not a pressing concern for scientific empiricism is the skepticism of van Fraassen's constructive empiricism. According to it, all their efforts at inductive reasoning are fictional. There is *nothing* that Penzias and Wilson can do to establish the real existence of this cosmic radiation. It is not directly observed by them. Thus, no matter what they do, they must suspend belief in the existence of that radiation. It is a limit to belief that no science can breach and not for a reason peculiar to the science. It is simply that, according to constructive empiricism, we have no warrant, in science or outside science, to believe in the reality of entities beyond observation.

This example illustrates how the propositional form of experience is the appropriate choice. This is not to diminish the importance of the traditional problems associated with cognitive experience. Here Reichenbach was right to insist on their worthiness. Rather it is to say that these problems are not specifically problems in philosophy of science. We can hope for a solution from epistemologists who specialize in these problems of cognitive experience. If they cannot find a solution, we do scientific empiricism no favors in visiting upon it an insoluble problem that is not specific to science.

9. Conclusion

This chapter has argued for a division of labor. The enterprise of empiricism overall extends from the most rudimentary of our sense experiences through to the most abstruse results

of science. The proposal is that an empiricism suitable for science should not be responsible for the entirety of this enterprise. Rather, its goal should be to investigate the role of experience in problems peculiar to science. That goal directs us to consider experience once it has been rendered in propositional form, such as would appear in formal, scientific writing. This divides empiricism into a cognitive analysis closer to the sense experience of individuals and a propositional analysis that seeks the import of experience in science, once it has been presented in a communally accessible form.

The division is prudent, I have argued, since the cognitive and propositional analysis employ different concepts and methods and, as a result of these differences, address different problems. They are each best treated separately.

That such a division of labor is advisable is a relatively recent development in history of empirical thinking. In the 1920s, when the modern tradition in empiricism was given new energy by such movements as the Vienna and Berlin Circles, it was still conceivable to their proponents that their analyses could embrace the totality of the empirical enterprise. Since that time, research in empirical psychology has shown that simple introspection gives a poor understanding of our sense experiences and mental processes. Properly accommodating these new results greatly complicates the burden of empiricist analyses that employ the cognitive notion of experience. A similar problem arises for the propositional notion of experience that, I have argued, is appropriate for empiricist analysis within science. Such analysis must now accommodate a philosophy of science that has a greatly enriched repertoire of results. Of special relevance is the growth in our understanding of inductive inference as it is implemented in the sciences.

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