

Science and Mātauranga Māori: Accommodation or Exclusion?¹

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Abstract

Concerning the relationship between Mātauranga Māori and science, advocates of Mātauranga Māori propose a range of different, incompatible positions. In section 1 the position in which Mātauranga Māori is said to be accommodated to science and its methods (advocated in *Vision Mātauranga 2007*) is distinguished from the claim that they are exclusive of one another (advocated in *Vision Mātauranga 2020*). Concerning the latter there are a variety of positions to consider depending on the kind of exclusiveness advocated. In section 2 a paper based in Mātauranga Māori on the causes of kauri dieback is shown to support accommodation rather than exclusion. In section 3 a slightly different kind of accommodation, rather than exclusion, is given further support through an examination of accounts of the poison in tutu plants. This is combined with an examination of a number of different kinds of knowledge to which ‘mātauranga’ can be taken to refer. Despite the many scientific papers which support accommodation, common claims concerning the status of Mātauranga Māori are more often than not exclusionist. This is discussed further in sections 4 and 5 through a consideration of remarks made by Mason Durie, a leading exclusionist. Issues are raised about whether the exclusionist position is committed to truth-relativism, what is meant by “working at the interface”, and whether methodological principles other than those discussed in section 1 are required, such as the idea of a scientific research programme and methodologies to do with reduction and holism.

Keywords: Mātauranga Māori, science, knowledge, indigenous knowledge, accommodation, exclusion, kauri dieback, tutu poison, methodology.

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1 Accommodation and Exclusion

Without initially getting bogged down in the definition of terms, in what ways is it claimed that science and Mātauranga Māori² relate, or do not relate, to one another? As a start, *Vision Mātauranga* (2007) tells us:

Scientific knowledge has superseded traditional Māori knowledge in many ways, however, Mātauranga Māori contains suggestions and ideas that may yet make a contribution to RS&T [Research, Science and Technology] (*op. cit.*, 16.)

Concerning the first clause, not only does science supersede traditional knowledge claims, but also science's own history reveals the ways in which it has revised its own claims and produced novel theories. There are two dynamics to take into account: the growth of science itself, and the interaction of indigenous knowledge with various sciences.

1.1 Accommodation.

This leads to the second clause which, for our purposes, is the more important. This says that Mātauranga Māori can make suggestions and ideas for adoption within RS&T. This presupposes that science has its own independent, distinctive methods of *test* which can be used to examine claims made within Mātauranga Māori; some of these might fail testing while others pass and are admitted into RS&T. Call this the “accommodation” position in which a claim of Mātauranga Māori accommodates itself to science in so far as its methods of test are concerned. (Note that Mātauranga Māori does not provide the methods of test; science does this. It would show the claims to be true or false, or have a high (or low) degree of probability; in some cases science would show that the claim is untestable. Nor does science necessarily accommodate itself to Mātauranga Māori in, say, externalist matters concerning what research to pursue. Here we are only concerned with Mātauranga Māori and science as bodies of “knowledge” and any modes of test and/or examination which they employ to establish their knowledge claims. Research pursuits can be independent of this.)

Such accommodation falls under the scope of one of the central principles of what Robert Merton calls the “ethos of science”, viz., “Organized Skepticism” which is both a ‘methodological norm and institutional mandate’ of science (Merton 1973, 277). This norm bids us to subject to careful examination any claim from any domain to determine whether it is true or false (or more broadly what degree of support by evidence it might have). This norm is *universal* in that it applies to any claims from science or elsewhere. As Merton notes, it might well lead science to ‘...invalidate particular dogmas of church, economy and state’ (*ibid.*, 278). We should add to this list “indigenous knowledge”; science might also come into

² This is commonly translated as ‘Māori knowledge’ and that will be provisionally followed here. In section 3 some suggestions will be made about alternative translations, e.g., ‘belief’ instead of ‘knowledge’, and the different kinds of knowledge to which it may be taken to refer.

conflict with Mātauranga Māori through the claims it falsifies (or shows to have low probability).

Many scientists adopt the accommodationist position concerning the relationship between science and Mātauranga Māori. *Vision Mātauranga* (2007) gives a primary role to science and its methods of *test*, and a subsidiary, but important, role to Mātauranga Māori in *suggesting* hypotheses for test. Note two matters: (a) hypotheses can have other sources, especially science itself; (b) nothing is said about Mātauranga Māori providing methods of test to apply to science – if there be such (a matter which needs historical investigation and is briefly touched upon in the discussion of proto-methods of science below). This division of labour is generally recognised in the philosophy of science in terms of the distinction between the context of *discovery* or *invention* of hypotheses and the context of *justification* or *test* of the proposed hypotheses.³

In the following two sections we will illustrate how this division of labour between science and Mātauranga Māori appears in the case of investigations into kauri dieback (section 2) and in the examination of aspects of the poisonous plant tutu (section 3).

1.2 Exclusion

In a successor document called *Rauika Māngai. A Guide to Vision Mātauranga*, published in 2020, nothing is said about this division of labour; a search of the document will not find the accommodationist phrasing of the second clause. Also, no comment is made as to why it is omitted. In the 2020 document much is said about issues which do not concern the status of science and Mātauranga Māori as bodies of “knowledge”, such as the employment of Māori in scientific research, the establishment of various kinds of scientific organizations, the ownership of property rights in research discoveries (a legal and not a scientific matter), and so on. The 2020 document is short on the enterprise of obtaining knowledge itself.

An exception is the contribution made by Mason Durie. But his position is not accommodationist, as the following indicates:

You can't understand science through the tools of Mātauranga Māori, and you can't understand Mātauranga Māori through the tools of science. They're different bodies of knowledge, and if you try to see one through the eyes of the other you mess up. (*Rauika Māngai*, 2020, 26)

We are not told what the different “tools” of Mātauranga Māori and science are such that each set of “tools” enables the understanding of just one of these domains but not both together. If these “tools” are understood to be methods for testing hypotheses, then the quotation says that the methods of scientific testing cannot be applied to the claims of Mātauranga Māori; and vice versa. This conflicts with both Merton's scientific ethos of Organised Scepticism and the accommodationist position. To mark the contrast let us

³ For an account of the two different kinds of context see Popper (1959/1934), Chapter 1, Reichenbach 1938: 6-7, and Salmon 2005: chapter 5.

describe this as “exclusion”. In sections 2 and 3 we will give examples of Mātauranga Māori/science interaction which support accommodation but not the exclusion.

We are not told in what ways Mātauranga Māori and science are different “bodies of knowledge”. There is an obvious, even trivial, sense in which, say, our theory of black holes and our account of genetics are quite different bodies of knowledge. And this is so because they involve different domains (astronomy and biochemical genetics) about which we can acquire some knowledge. In fact, it is all too easy to generate examples of such different bodies of knowledge; there are multitudes of such pairs. Are Mātauranga Māori and science to be understood to be about such quite disparate domains? If so, this is an extreme kind of exclusion in which neither is about the same kinds of thing as the other. What needs to be spelled out is a plausible sense in which these are different bodies of knowledge and yet they are somehow competing about the same matters. But this is something which needs careful explanation.

Not much more elaboration of the exclusionist position can be found in *Rauika Māngai*, 2020. But in an earlier paper Durie had already spelled out his version of exclusion:

Indigenous knowledge cannot be verified by scientific criteria nor can science be adequately assessed according to the tenets of indigenous knowledge. Each is built on distinctive philosophies, methodologies and criteria. (Durie 2004, 2)

What was earlier called “tools” become in the immediately above quotation not only the process of verification (and presumably falsification) but also philosophies, methodologies and criteria. It is worth spending some time exploring some of the above since the denial of the accommodationist position turns on it.

If one means by verification “showing a claim to be true”, then, where an indefinitely large, or infinite, domain of investigation is involved, neither indigenous nor scientific knowledge can be verified. This has been recognised in the standard accounts of inductive inference from the 18th century philosopher David Hume onwards. Consider either the particular claim that the sun will rise tomorrow, or the general claim the sun will always rise on the next day. It is commonly recognised that all our past observations of the sun and its rising are not able to verify (show or prove true) either claim. At best our past observation will give these strong (inductive) support. In this respect both indigenous knowers and scientists, like the rest of us, are not in a position to *verify* either claim; we have to be content with less than verification. No one can adopt an exclusionist or an accommodationist position with respect to verification methods of the sort Durie canvases.

Talk of distinctive philosophies and criteria is vague; so, let us focus on methodologies, a term not always used with a clear meaning by advocates of Mātauranga Māori. One can ask: ‘methodologies for doing what?’ We can glean from what Durie says that a methodology, when applied to a body of beliefs, is used to produce some items as outcomes (of science or of Mātauranga Māori). In answer to the ‘doing what?’ question, here is a very brief,

incomplete list of six kinds of method and their outcomes to be found in science⁴. Most of these are logical or epistemic in character, but the sixth concerns ethical matters.

(1) There are distinctive observational methods, for example the preparation of specimens for observation under an electron microscope, or Jane Goodall's observation of chimpanzee behaviour, or observation of planetary positions. The outcomes from these methods are sets of observational reports or data.

(2) There are experimental methods, for example the special techniques involved in, say, the detection of solar neutrinos in underground tanks of a chlorine fluid; or Mullis's now common polymerase chain reaction (PCR) used on small segments of DNA to amplify molecular genetic structure (DNA "fingerprinting"). The outcomes from these methods are, again, sets of data.

(3) In the above we have been careful to talk of methods of *test* for hypotheses. Tests will include, for example: randomized clinical trials⁵; methods for establishing correlations from data and even ultimately causal claims⁶; the hypothetico-deductive method (in which hypotheses are applied in some situation and their logical consequences examined)⁷; application of Bayes's Theorem to sets of hypotheses and evidence⁸; and so on. The outcomes of these methods of tests will be theories, or hypotheses, to be accepted, or rejected (or assigned some degree of probabilistic support).

(4) Methods for the *discovery* or invention of hypotheses. Given some data it is possible to discover, using algorithms, hypotheses which fit the data to varying degrees of fit (see Langley *et al.* 1987). Outcomes of the application of algorithms to data will be laws, or hypotheses, or generalisations.

(5) The methods of logic, for example, the use of inductive inference on data, or the use of deduction in applying *Modus Tollens* in the refutation of hypotheses, or the making of inferences in mathematical applications to science.

(6) Guidelines and precepts concerning the treatment of human subjects in experimentation and health care in general, including decision-making which observes tikanga Māori. The outcomes will be the appropriate and respectful treatment of human subjects.⁹

There are other answers to the 'method for what?' question (a 7th will be given in section 4 and an 8th in section 5). But the above brief characterizations will suffice for the purposes of characterizing differences between the positions of accommodation and exclusion.

⁴ Durie hardly discusses what are the tools or methods of Mātauranga Māori so the illustrations chosen above largely come from science. A seventh methodological precept and its outcomes has an application to Mātauranga Māori; see section 4.

⁵ Foundational work in the reforms of experimental techniques and statistical inference leading to the methodology of randomized trials in sciences from agriculture to medicine would include at least Fisher 1935; on the evolution of statistics in medical experimentation see Hill, 1977/1937.

⁶ On issues concerned with testing for correlations and cause and effect, see Pearl and McKenzie 2018.

⁷ The hypothetico-deductive method is basic to the approach of Popper 1959, chapter 1.

⁸ The contemporary leading approach to the methodology of testing, not commonly recognized in Mātauranga Māori, uses Bayesian methods. Of the many works on Bayesianism see for example, Howson and Urbach, 2006.

⁹ There is considerable literature on this, in particular Hill 1977/1937 Chapter 20. On research ethics relevant to Māori in universities, see, for example, *Te Ara Tika*. There are also related animal ethics precepts to consider.

Durie's exclusivist stance is that each of Mātauranga Māori and science 'is built on distinctive methodologies ...'. This can be expressed by the following claims (where, again, a distinction is drawn between methods used and the outcomes, usually "knowledge", obtained by using these methods and 'D' indicates that they are theses due to Durie):

- (D1) Methodologies (and philosophies and criteria¹⁰) of science are used to assess the body of scientific "knowledge".
- (D2) Methodologies (and philosophies and criteria) of Mātauranga Māori are used to assess the body of "knowledge" of Mātauranga Māori.
- (D3) The two Methodologies (and philosophies and criteria) of science and Mātauranga Māori are distinct (as are their respective bodies of "knowledge").

Even though they are distinct, Durie is not always clear about whether the two methodologies can share some items in common; the emphasis on distinctiveness suggests not. Clarification on this point is gained from the following quotation: 'Science is one body of knowledge and indigenous knowledge is another. It is important that the tools of one are not used to analyse and understand the foundation of the other ...' (Durie, 2004, 7-8) Here it is made clear that, for Mātauranga Māori and science, their tools of analysis, i.e., the methodologies, are quite distinct as are the two bodies of knowledge they help create. This is a quite strong version of exclusiveness.

Can the exclusion of methods expressed in (D3) be right? Does not Mātauranga Māori employ methods of reasoning, that is, logic (as in (5) above)? It is hard to imagine human communities which do not employ at least some reasoning whatever understanding they might have of it. Māori, like any other community in the world, would have evolved the capacity to reason about aspects of their world as well as form beliefs about it.¹¹

Again, doesn't Mātauranga Māori apply appropriate methods of observation in given domains (as in (1) above) for example wind, current, bird flight patterns, etc, for the purposes of navigation? Given the right training, skills and interests most humans will readily make the same observations as, say, sea navigators would make. Piano tuners are another example. We all learn to make observations of the world around us, and with training can become proficient in some specialized domain of observation, such as navigation or piano-tuning.

It is unclear what Mātauranga Māori says of methods of *test* or *discovery* in a pre-scientific context. Clearly some methods must have been employed when the poisonous nature of tutu plants or karaka berries were first encountered, but we have no record of this. However, it is possible to recognise that these methods of science also have a history and that societies might have employed earlier versions of these methods rather than the more sophisticated versions found in contemporary science. These methods can be called *proto-scientific methods*; and for logical reasoning even *proto-logics* can be admitted! Once these are

¹⁰ Though philosophies and criteria have not been discussed it is appropriate to include them as part of what Durie thinks are used to assess bodies of "knowledge".

¹¹ There are several theories about the general human capacity to reason arising out of the theory of evolution. We will only cite one such work in argumentation theory, Mercier and Sperber, 2011.

recognised it can be seen that Mātauranga Māori and science could share methodological principles, even though the former uses only the proto-scientific forms of the latter.

We take the view that people in all human cultures share the capacity to form beliefs and to reason about them (we advanced this as a scientific hypothesis about human evolution). A good illustration is the following. A common “gold standard” of scientific investigation is the method of randomized clinical trials (with or without blinding) used in experiments from agriculture to medicine. We owe this standard to the reforms in statistical reasoning introduced by R. A. Fisher in the 1920s and subsequent work by people like Austin Bradford Hill in the field of medicine. Before the 20th century people did conduct trials, but they were faulty in many crucial respects. For example, James Lind in 1747 conducted a trial on sailors which showed that citrus fruit would lessen the effects of scurvy on them while other contemporary remedies would not. By modern standards Lind’s controls were inadequate, and the sample size of two sailors who took citrus fruit was too small. It is important to note that in earlier centuries some believed that citrus fruit would cure scurvy. But these beliefs, though right, were not enough; what was needed was a proper scientific test to provide evidence of citrus fruit curing scurvy. There is a big difference between the common beliefs we humans happen to hold, and those beliefs we hold because they have passed tests.

Again, Bible scholars point to an account of a controlled experiment concerning what healthy food should be eaten in *Daniel* 1: 12-15. It was proposed that people be divided into two groups: one group eats only vegetables and drinks water for ten days while the other partakes for ten days of any food on the King’s table. At the end of ten days it was judged that the first group looked healthier. Again, this is a proto-clinical trial; but it lacks good sample size, randomization, etc. (can we suppose that participants gave free, informed consent?).

In the light of this we can say that, before the use of a properly developed methodology of clinical trials, humans in various cultures did use methods found in current science, even though they might have been inadequate in various ways; hence they are *proto*-methods of reasoning, either logical or methodological. It would be up to historians of human forms of reasoning to adjudicate on whether any case employed proto-methods, or not. Of course, not all principles of method will have a proto-form, but many do.

If we admit the above then we have good grounds for rejecting a strong version of Durie’s claim (D3) that Mātauranga Māori and science have exclusive methodologies of test (as well as bodies of “knowledge” as outcomes). Mātauranga Māori can share either contemporary methods of test or use proto-versions of later methodological principles of contemporary science. Admitting this seriously weakens the claim (D3) concerning exclusivity.

This suffices for an initial account of the kind of exclusion that Durie advocates; more will be said in section 4, including his claim that, after all, there can be work done at a common “interface” between Mātauranga Māori and science (whatever that be). Exclusion can come in many different shades. If we imagine the two doctrines being placed on a line then accommodation can be placed towards one end and the varieties of exclusion on the rest of

the line, with extreme versions of total mutual exclusion of ontology, methodology, reasoning, philosophy, etc. at the other end.

Others propose different versions of exclusion. The following is a more extreme version:

There are some problems when thinking about research methodologies as they apply to IK [Indigenous Knowledge] mātauranga. One problem of methodology exists because of the marginalised status of IK mātauranga as a system of knowledge, a way of knowing and being; a further related challenge lies in proving that it exists as a legitimate, that is proven, knowledge. The problem may also exist because some aspects of IK mātauranga are fundamentally incommensurate with other, established disciplines of knowledge and in particular with science, and are a much grander and more ‘mysterious’ set of ideas, values and ways of being than science. (Smith *et al.* 2016, 139-40).

Here the term ‘methodology’ might be being used in quite different ways from those already indicated (a matter which will not be pursued). But a crucial term indicating a more extreme version of exclusion is ‘incommensurate’. This dates from the 1960s philosophy of science of Thomas Kuhn and Paul Feyerabend in which, in various highly contested ways, pairs of scientific theories were alleged not to be comparable. This now dated doctrine¹² is used by some to claim that Mātauranga Māori and science cannot be “comparable” with one another, i.e., comparison on the basis of evidence is not possible. Such alleged incommensurability provides another way of ruling out any accommodationist scientific testing of the claims of Mātauranga Māori; that is, one is not capable of taking on the suggestions and ideas of the other. This is clearly a strong position on exclusion.

As a final version of exclusion consider a publication of the *Royal Society of New Zealand* in which we are told:

Mātauranga is its own system with its own organisation, and it is this system and organising that we want to prioritise. (Broughton and McBreen, 2015, p. 84).
Although there will be opportunities to work together, that is not the goal of revitalising mātauranga. The goal is not partnership; it is tino rangatiratanga and instituting mātauranga as a primary and independent knowledge system. (*ibid.*, 86).

These remarks clearly make a claim for the independence of Mātauranga Māori from science even though it is not spelled out what kind of independence is being claimed.

2 Kauri Dieback and Accommodation.

This and the next section discuss papers in which Mātauranga Māori is a source of hypotheses for scientific investigation (as suggested in *Vision Mātauranga 2007* but not the

¹² For one of the many criticisms of the doctrine of incommensurability see Devitt 1997, especially chapter 9.

2020 version). As such they support the accommodationist stance but not the exclusionist stance.

Lawrence *et al.* (2019) describe a study on the potential control of kauri die-back in New Zealand, known to be caused by a pathogen called *Phytophthora*. The task has been to find anti-*Phytophthora* compounds, particularly those which might be generated by native plants growing in kauri forests. They tell us: ‘Mātauranga Māori was used as the basis for selection of four endemic plants for anti-*Phytophthora* screening. The knowledge used to select these plants descends from Te Whare Wananga o Ngāpuhi (the sacred house of learning of Ngāpuhi)’ (Lawrence *et al.* 2019: 3). The house of learning proposed that four plants could be examined for their anti-*Phytophthora* properties: kānuka, karamu, kawakawa and nikau.

More specifically, the researchers considered the effects of preparations of the leaves and roots of each of these plants, thus generating eight hypotheses about the possible negative causal effects on *Phytophthora*. These eight causal hypotheses were scientifically tested for their action against the pathogen threatening kauri growth. Only the extracts from the leaves (not roots) of one of the four, kānuka, proved promising. The authors are cautiously optimistic about their results saying: “These results suggest that, while not useful for treating existing plant infections, kānuka could have potential applications in limiting zoospore mediated spread of disease. ... any potential applications will require significantly more research.” (*ibid.*, 14)

To what extent was Mātauranga Māori involved in the processes of scientific testing? It did call on the “Ngāpuhi sacred house of learning” which suggested four-plant-hypotheses for test, or eight hypotheses about the casual efficacy of the roots and leaves of these four plants. But that is all; the crucial matters of scientific test lie elsewhere and are not part of what is on offer from the “sacred house of learning”. (For the purposes of this discussion we assume that the scientific investigation of the effects of the leaves and roots of the four plants has been carried out correctly; the authors do have a detailed discussion of these matters.) It should also be noted that theories of confirmation, of refutation, and of hypothesis testing generally (e.g., Bayesianism), were not originally part of Mātauranga Māori.¹³ We make five points on this scientific episode.

The first is that, as far as science is concerned, Merton’s precept about Organized Scepticism allows that hypotheses can be suggested for test from all areas of life, e.g., from other sciences, from common everyday beliefs, from myths, from religion, from “a sacred house of learning”—and from even dreams.¹⁴ This is part of the universality of science; tests may be

¹³ Some who wish to espouse an up-to-date version of Mātauranga Māori might wish to embrace the methods of current science. But that is ruled out by the exclusionist stance, as we have seen.

¹⁴ The classic case of a dreamed hypothesis in the science literature is that of the organic chemist August Kekulé who tells us that he knew that the chemical composition of benzene was C₆H₆ but did not know what its structure was – until he fell dozing in front of a fire and saw a snake chasing its tail. Then he realized that benzene had a ring-like structure. Being a good scientist Kekulé did not accept his dream as evidence for the structure. Rather, he then spent some time in the laboratory getting evidence for this hypothesized structure.

devised for any kind of hypothesis drawn from anywhere. Science arises in the *testing* of hypotheses (often called, in the philosophy of science, *the context of justification*) and not necessarily in the suggestion of hypotheses in the first place (often called *the context of discovery* or *invention* of hypotheses for testing).

The second point is that the model of science in which we separate out the context of *justification* from the context of *discovery* or *invention*, is clearly suggested in Karl Popper's model of hypothetico-deductive test to be found in the first chapter of his *Logic of Scientific Discovery* (Popper 1959/1934).¹⁵ Popper adopts the strong, somewhat controversial, view that there is no method for *inventing* hypotheses in the first place. We can find hypotheses anywhere, even in religion, myths or dreams; but once we have them, we can, if we wish, subject them to test (if they are testable). In this sense the science of testing is universal; no hypothesis is immune from testing. Here it is important to adopt the critical attitude in science and subject our beliefs to test and not venerate them or make them immune from test.

The third point is this: once tested, do the hypotheses fail or pass? Of course, we would like any "house of learning" to suggest hypotheses which pass tests. (We do not know from where the "house of learning" gets its hypotheses and we are not told; though we have no evidence, perhaps a case can be made for Māori proto-scientific methods of discovery at work.) But, alas, many of the hypotheses suggested by "the house of learning" fail their tests. Of the eight tested, seven failed; and the eighth is highly qualified. So, the "house of learning" is not a reliable generator of true hypotheses, and in this case it has a failure rate of at least seven out of eight.

A fourth point follows from this. In footnote 1 a question was raised about the understanding of Mātauranga. Is this to be translated into English as 'knowledge' or something else, such as 'belief'? We commonly take 'knowledge' to be factive. That is, propositional knowledge involves truth in that the following entailment holds (for any proposition p): if a person *knows that* p, then p is true. So if p is false the knowledge claim has to be withdrawn. As the example of the kauri dieback hypotheses shows, Mātauranga Māori is rather about *belief* and not *knowledge*. Unfortunately within most accounts of Mātauranga Māori, the belief/knowledge distinction is hardly drawn. What needs to be recognised is that Mātauranga Māori can also give us *beliefs* for test (and these beliefs are either shown to be true or false).

The fifth and final point is this. Other experimental work suggests other hypotheses concerning possible anti-*Phytophthora* agents. For example, possible fungal and bacterial agents found in the soils in which kauri grow have been investigated for their anti-*Phytophthora* properties (Byers et al. 2020). These, of course, differ from the search for anti-*Phytophthora* activity in the leaves or roots of plants. These results are still preliminary but if they turn out to be positive then the mātauranga of the sacred house cannot be said to provide knowledge; at best it provides beliefs which turned out to be experimentally false.

¹⁵ For two other advocates of the idea that there are two contexts to consider, that of justification and invention, see footnote 2.

In conclusion, it is clear that the investigation into aspects of kauri die-back itself required detailed scientific procedures of test well beyond those provided by the house of learning, which merely provides hypotheses for test. As such it supports the accommodation of Mātauranga Māori within science rather than exclusion; and it does this despite the fact that most of the hypotheses have been proved wrong.

3 Tutu Plants, Accommodation and ‘Mātauranga’.

In this section investigations into tutu plants will be used to illustrate the accommodationist stance. But it will be done slightly differently through an examination of the different kinds of uses of the expression ‘knows’.

The expression “Mātauranga Māori” is often translated into English simply as “Māori knowledge”. Mātauranga is an abstract noun, as is the English ‘knowledge’; these terms come from the verbs ‘matatau’ of Māori and ‘know’ of English.¹⁶ ‘Mātauranga’ is an omnibus, even ambiguous, expression and is as broad as the English term “knowledge”, as will be seen. For the present, we will go along with this translation. But further alternatives might be “Māori beliefs” or “Māori belief systems”. In fact, some writers give us a broad range of epistemic terms as a translation of ‘Mātauranga Māori’: ‘The term has many definitions that cover belief systems, epistemologies, values, and knowledge ...’ (Awatere and Harmsworth 2014: p 3). This indicates that ‘Mātauranga’ does not always parallel the usage of the English ‘knowledge’. In what follows in this section we will consider some of the kinds of knowledge that there are, and then raise the question whether these kinds are universal in all languages or not.

The following is a list of some of the different linguistic forms the verb ‘know’ takes in English (but which might have direct parallels in other languages). Knowers can be either some individual person or group (such as Māori, or more correctly Iwi or Hapu as the more primary source of knowledge); for convenience they will be denoted by ‘X’. The grammatical objects of ‘knows’ will be propositions (statements or completed sentences) and will be denoted by ‘p’; for example, that $2+2=4$, that Matariki usually occurs in late May or early June, etc. At the same time in illustration of the kinds of knowledge, reference will be made to tutu, the poisonous, native New Zealand plant. There are many linguistic forms the verb ‘know’ can take; we will consider just six of them.

(1) *Knows that p*. The letter ‘p’ following the verb can be replaced by a proposition; for this reason it is called *propositional* knowledge. For example: *X knows that tutu is poisonous.*

¹⁶ Intriguingly Royal (2009: chapter 5) suggests that ‘Mātauranga’ might be a term which originated in Maori during the 19th century, possibly under the influence of the Bible; or it might have been an old term which was given a new meaning in 19th century. We leave this matter to linguistics scholars to investigate.

One might ask: how did Māori know this? This question asks a very different matter concerning evidence for the claim that tutu is poisonous; it does not concern the linguistic structure of *knows that p* which we are characterizing in talking about the different linguistic forms that ‘know’ can have. However, a brief comment on the evidential matter - and then set it aside. There does not appear to be any direct, historical evidence about how Māori came to know this. But it can be appropriately claimed that they made an *enumerative inductive* inference from individual cases of poisoning by tutu to the generalization: all tutu plants are poisonous. In much the same way from all the individual deaths that have occurred we infer ‘humans are mortal’; from all the individual sips of water we take, we infer ‘water quenches thirst’, and so on. We can take this kind of inductive form of reasoning to be an inference or, more grandly, to be a proto-principle of scientific method which most people in all cultures have employed in their reasoning about the world. We take it that humans (and animals as well) have evolved at least to be “inductive machines”.

(2) *Knows what* (definitional knowledge). For example, X *knows what* tutu poison is. Early scientific investigators isolated the poison and called it ‘tutin’. So, we could say, uninformatively: X *knows what* tutu poison is, viz., tutin. However more information is provided when specifying the chemical formula for tutin: X *knows what* tutin is, viz., the chemical substance with formula $C_{15}H_{18}O_6$. This distinctive chemical was discovered in 1900 by Esterfield and Aston in the leaves and seeds of tutu. The structure of this molecule was discovered much later by Craven in 1963. In these two papers chemistry is the science employed, along with chemistry’s standard modes of investigation at the time. There is no reference to Mātauranga Māori. *Knowing what* ... in these cases is *knowing what* is the chemical nature of the substance tutin.

(3) *Knows how* (explanatory knowledge). For example, we can say that X *knows how* tutin causes “poisoning”. What is the “poisoning” and how does it act? It attacks the body’s glycine receptor which helps control neurotransmission in the spinal cord and the brain stem. Tutin acts as an antagonist with the result that there is loss of control of motor neurons and of muscles. That tutin affected the nervous system was noted by its initial discoverers; but it was much later work which showed, by what means, tutin acted upon particular aspects of the human nervous system. Again, there is no Mātauranga Māori story to be told here; the explanation is entirely within the sciences of chemistry and physiology.

It is important to note the difference between (1) and (2), and the difference between (1) and (3). X might *know that* tutu poisons but not *know what* tutu poison is. In much the same way a person might *know that* aspirin relieves headaches (on the whole) but not *know what* aspirin is. In a similar fashion X might *know that* tutu poisons but not *know how* it poisons (i.e., provide an explanation). In much the same way a person might know that aspirin relieves headaches but lack an explanation, i.e., not *know how* aspirin produces headache relief. Propositional knowledge is very different from explanatory knowledge, though the later can be expressed as the former.

(4) *Knows why* (another form of explanatory knowledge). Suppose we

say: *X knows why* tutu causes poisoning. What can we say that X knows in the way of an explanation? It is not clear. But one suggestion is an evolutionary story in which some plants evolved certain kinds of ability to poison animals or insects that might eat them. So, an explanation can be filled out from within Darwinian evolutionary theory. But perhaps no one *knows why* tutu acts in the way it does; it remains an open matter.

(5) *Knows* . . . , where the blank is filled by a direct object. This is a version of *knowledge by acquaintance*. Thus, we may say: X *knows* (is acquainted with) Auckland (i.e., knows the way about) but X does not know Wellington (X gets lost); X *knows* (is acquainted with) the Prime Minister (is a friend, or can pick them out in a line-up, etc); X *knows* kauri trees (i.e., can identify them). In the light of the last example, we can say that X *knows* tutu in the sense that X can recognise a tutu plant when X sees one in the bush.

(6) *Know how to* . . . Here the verb ‘know’ denotes a skill or an ability. Thus we say: X *knows how to speak te reo*; X *knows how to* choose trees for making waka; X *knows how to* do multiplication; and so on. A further example is interesting. Māori (and subsequently early settlers) *knew how to* make a non-intoxicating drink from the juice of tutu berries - once the seeds had been strained out (Fitchett and Malcolm 1909: 336). Fitchett and Malcolm largely report on the toxic effects of tutin on a variety of animals, including humans. (In 1869 one Government analyst, W. S. Skey, even tried the poison on himself!) This highlights the interesting point that Māori *know-how* in this case involves *know that*; hence the separation of the seeds from the berry juice. That is, we can say that Maori *knew that* tutu berry seeds were poisonous; also, they *knew that* the juice was not poisonous.

Two points arise from the above six cases. First, accommodation is illustrated through the different “knowledge” claims that can be made about tutu plants and their poisonous properties; claims of Mātauranga Māori co-exist alongside claims of science and, moreover, are explained by them. None of this supports exclusion. However, note that Mātauranga Māori is employed in three kinds of “knowledge”, viz., *know that* . . . , *know how to* . . . , and *know* . . . (by direct acquaintance). But Mātauranga Māori is not part of any further story to be told about knowledge of chemical substances, *know what* . . . , or the two kinds of explanatory knowledge, viz., *know why* . . . and *know how* Rather it is scientific theories and scientific practices which relate to these kinds of knowledge.

The second point concerns our understanding of mātauranga. Is it factive like the English ‘know’ (i.e., does knowing that p imply the truth that p)? Does it admit of the six kinds of uses of ‘know’ found in English? Is *knows that p* to be contrasted with belief that p? Does the former entail the latter, but not conversely? Are the different linguistic constructions of the verb ‘matatau’ the same as in English, or different? These are questions which will not be addressed here.¹⁷ They concern matters which need to be clarified as far as epistemic notions

¹⁷ Another matter hardly discussed in Mātauranga Māori is the theory of epistemology from the Ancient Greeks onwards. It is no use complaining that this is “western” philosophy to be set aside in Mātauranga Māori. Much the same kinds of considerations can be found in Hindu philosophy at the same time or earlier. Failing to note these doctrines also leads to the neglect of the tradition of scepticism in epistemology. This would put

in Māori are concerned. We cannot assume that the supposed English translations of Māori epistemic terms will accurately reflect what they mean.

Over the last twenty years or so there has developed a research project looking into such matters. Some of this interesting work, done by philosophers, linguists and cognitive psychologists, has been collected in Stich *et al.* 2018. Much attention has been devoted to the use of English expressions such as ‘know’ to express epistemic concepts. So, what happens in other languages when their epistemic counterpart words are considered? In the Stich *et al.* collection, aptly named *Epistemology for the Rest of the World*, a host of other languages are explored, such as Sanskrit, Japanese, Chinese (modern and ancient), Hindi, native American languages, some Australian aboriginal languages, and so on. Alas Polynesian languages, including Māori, are not discussed; it remains to extend this research project to Māori.¹⁸ So, no answer can yet be properly given to the above questions. This involves research which cannot be undertaken here. So we will stay with the English rendering of Maori epistemic terms even though that might be deemed to be not fully adequate.

4 Research Programmes and ‘Working at the Interface’.

The above provides some examples of the accommodation of Mātauranga Māori to science. More papers could be cited in which the accommodationist stance is adopted. So, what status does the contrasting exclusionist position have? In the light of the number of papers which endorse the accommodationist position, the unclear formulation of Durie’s version of exclusion (D3) (in section 1), and the number of counterexamples already provided to exclusion about methodology, there might be good grounds to set exclusion aside as an unsatisfactory doctrine.¹⁹ But before doing this it will be useful to consider further claims that Durie makes on behalf of exclusion. The first concerns the methodology of a whakapapa research programme and the second, Durie’s idea of “working at the interface”.

4.1 Whakapapa as a research programme.

Durie’s approach to this is through a suggestion of Charles Royal:

Royal has described a research paradigm, Te Ao Marama, that employs a whakapapa methodology to develop new knowledge. Though based on Māori world views and not in his opinion readily transported out of a Mātauranga Māori (Māori knowledge) context, it has potential for guiding the discovery of new knowledge and has application for understanding the nature and origin of phenomena, the connections and relationships between phenomena, and the trends that occur with phenomena. (Durie, 2004: 11)

constraints on those who over-enthusiastically make knowledge claims when none is to be found and, instead, one would have to settle for much less, viz., belief.

¹⁸ We agree with Royal (2009: 87) who says: ‘no comprehensive explanation of all Mātauranga Māori concepts concerning knowledge and knowing currently exists ...’.

¹⁹ Scientific papers based on a strong exclusion are hard to find.

Royal has much to say about how such a whakapapa research programme might work. For our purposes a relevant comment is the following:

The third part of our theory turns to the all-important issue of methodology. By what process or processes is Mātauranga Māori created? What is the nature of that process? Our interim response to these questions is to posit whakapapa, or genealogy, as a research methodology. In the course of our research we have discovered that whakapapa was used traditionally to generate explanations for many things in the phenomenal world. Hence, one can find in the 19th century manuscripts of writers such as Te Matorohanga of Wairarapa, Te Rangikaheke of Te Arawa and Matene Te Whiwhi of Ngati Toa, a vast array of whakapapa for such things as flora and fauna, for water, for sunshine, for human beings and for a vast array of naturally occurring phenomena. The tantalising proposition is therefore posed. Can everything in the world be accounted for by whakapapa? Can whakapapa generate relevant, pertinent and useful explanations for all things? (Royal, 1998: 2)

Here whakapapa concerns not only the historical relations and genealogy of human beings but also an approach to all naturally occurring phenomena – and even the very process of the creation of Mātauranga Māori itself. Royal’s talk of a “research methodology” suggests a link to issues in the philosophy of science, such as the *methodology of scientific research programmes* developed by Imre Lakatos (1978, chapter 1). This takes us to the 7th on our list of methodological principles (see section 1 for the first six). Very briefly, this methodology asks us to consider (i) some principles for the “hard core” of a programme, constructed, for example, out of the principles which govern whakapapa, and (ii) heuristics for the development of the “hard core” to account for relevant facts. For example, it remains an open question how the whakapapa programme might solve issues concerning particular phenomena in the world, such as sunshine (as Royal suggests above). (Royal does go on to sketch a way in which the programme can be developed which we will not discuss.)

Lakatos also provides a way of assessing each programme as *progressing*, *stagnating*, or *degenerating* with respect to their relevant facts. It would be progressive if it produced new facts for science to consider, stagnating if it produced none, or degenerating if merely accommodated itself to relevant facts discovered progressively in a rival programme. The same considerations can apply to pairs of competing research programmes. Within the context of accommodation, the whakapapa research programme would have to take its place alongside other rival research programmes which apply to the same domain, for example, the synthesis of the theory of evolution and genetics. No assessment will be made here of how the whakapapa research programme would compare with any rival research programme as progressive, stagnating or degenerating.²⁰ The main point is that if it is understood as a

²⁰ Some might suggest that the whakapapa research programme would degenerate. Te Maire Tau tells us: ‘There is no account seen by the writer that suggests the whare wananga encouraged rational debate that challenged the traditions themselves rather than the details of the traditions. Indeed, it would appear that by the arrival of Pākehā the traditions were becoming increasingly solidified. Take, for example, Tikao’s explanation to Hemes Beattie that the Earth was flat ...’. (Tau, footnote 19: 151).

Lakatosian research programme (and Royal does use language which suggests this), it would legitimately take its place within science, i.e., it makes an accommodation with science. This accommodation takes place irrespective of whether scientific testing shows it true or false (or in the case of Lakatos's methodological criteria for testing, the programme is progressive, stagnating or degenerating)

Such an account is useful in understanding Royal's suggestion. But it does not help Durie in any exclusionist account of whakapapa as a body of indigenous "knowledge". Initially the whakapapa research programme was proposed by Royal and adopted by Durie as a way for uncovering new knowledge. But if it takes its place as a Lakatosian research programme then it gives more support to accommodation than to exclusion (again, irrespective of whether the methodology of testing shows the programme to fail rather than succeed).

4.2 *Research at the Interface.*

Durie suggests there are three kinds of research to consider:

- (1) Mātauranga Māori research, i.e., research that is conducted entirely within the context of Māori knowledge and Māori methodological approaches. (Durie 2004, 8.)
- (2) scientific research that employs only those approaches consistent with empirical scientific principles. (*loc. cit.*)
- (3) ... indigenous researchers who use the interface between science and indigenous knowledge ... have access to both systems and use the insights and methods of one to enhance the other. (*loc. cit.*)
- (4) ... attempts to utilise two sets of values and methods not simply to bridge the benefits that might arise from each, but ultimately to produce gains for indigenous peoples most of whom live at the interface. (*loc. cit.*)

Now Durie usefully points out that people often live at the interface between two systems of "knowledge" (more accurately systems of belief). There are indigenous people who, say, live the life of the colonized while not giving up on their indigenous beliefs. There are scientists who have religious beliefs not reconcilable with their science. A similar situation might arise in science as when, for example, a scientist might use classical mechanics (because, say, it is more convenient to use) when they know full well that quantum mechanics, or general relativity, is the more correct theory to use. Let us grant this.

A question remains about how an exclusionist stance might gel with the possibility of "working at an interface" in the way (3) suggests. We can readily agree that such a worker would have access to both systems. But how are the methods of the one system to be used on the other when, by supposition, each system has its own exclusive set of methods? There is no interface if the two sets of method, and bodies of "knowledge" that they produce, are exclusive of one another.

Moreover, how are they used to produce knowledge which is an "enhancement"? The criteria of enhancement, i.e., better "knowledge", would have to be common across the two systems; but such methodological considerations are not to be admitted given the exclusionist stance alleged of the methods of science and the methods of Mātauranga Māori.

Accommodation has a better account of what “working at the interface” might mean because it allows that, between science and Mātauranga Māori, there may be both a sharing of “knowledge” (see the different kinds of knowledge about tutin in section 3) and a sharing of methodological principles. What Durie takes away with the one hand (viz., any sharing of “knowledge” and methods) he must give back with the other if there is to be any interface at all.

5 Relativism and a Further Methodological Principle

5.1 *The Spectre of Relativism*

The positions discussed above are well illustrated in the following table (Durie, 2004, 10; Durie 2005, 307).

<i>Mutual Respect</i>	<i>Shared Benefits</i>	<i>Human Dignity</i>	<i>Discovery</i>
Recognition of the validity of each system of knowledge.	Indigenous communities share benefits of research including intellectual property and commercialisation	Cultural and spiritual beliefs and practices are reinforced by research. Indigenous world views are not compromised.	Innovation and exploration using indigenous methodologies and scientific methods.

In the first column on the left, if we understand ‘validity’ to mean correctness or truth, then we have two systems of “knowledge” both of which are alleged to be true. This can be trivially so if the two systems are about quite different domains (such as cosmology and genetics). But if they are about the same domain then we would have to say that this mutually respectful stance commits us to the correctness of two different systems of knowledge which are, by supposition, about the same domain. This is an obscure claim about which we can only make a hypothesis about what it means. One way of remaining respectful is to go relativist and say, for some proposition *p* in “knowledge” System 1, *p* is true-relative-to-System-1 but *p* is not true-relative-to-System-2. What is true is relative to the system we adopt; there are no “objective” truths. This position maintains respect for two systems of knowledge but at the high cost of adopting a relativism about truth. Many have argued since Plato’s *Theaetetus* that truth relativism is a self-refuting doctrine (an issue not discussed here²¹).

We can pass over the next column because it concerns legal matters and not Mātauranga Māori and science as bodies of “knowledge” and methods. The third column invites us to restrict Merton’s norm of Organised Skepticism for science and not question religious beliefs. Many would find this restriction on what we can investigate unacceptable. Moreover, there is no account of religious beliefs which would make such beliefs in one system (say indigenous

²¹ For an idea of some of the self-refuting considerations, see Burnyeat 1976.

knowledge) not possibly comparable from the stance of the other system (science). Since for atheists and believers, issues of science and religion can be discussed and disagreed about, then there is nothing obviously “incommensurable” about the two systems (i.e., there is not something about the two systems that makes them not comparable). Finally, the fourth column taken in the context of the others, emphasizes again that the two bodies of “knowledge” Mātauranga Māori and science and their respective methods, are exclusive of one another; and it is such exclusionism which has been the object of criticism in this paper.

5.2 Reduction and Holism as Methodology

The role of methodology has featured prominently in the above. So far we have mentioned briefly seven kinds of method employed in science (and sometimes Mātauranga Māori). As a final matter an 8th methodological principle will be mentioned. Durie raises

[a] third concern ... linked especially to methodology. While analysis into smaller and smaller components is a standard scientific method, indigenous knowledge places greater emphasis on the construction of models where multiple strands can be accommodated to make up an interacting whole. (Durie 2004: 7. Also Durie 2005: 18.)

Often science is said to be reductionist (e.g., from wholes to parts) while Indigenous Mātauranga Māori is often said to be holistic. (This is a term introduced by the South African General Jan Smuts in 1926 in his book *Holism and Evolution*, though Smuts might have meant something different from contemporary meanings in his talk of the evolution of wholes from unit parts.)

Some might see this as advocating exclusive methodologies of Mātauranga Māori and science; the former is said to be anti-reductionist and holistic while the latter is non-holistic and reductionist. But this is to give the Durie quotation too strong a reading. It is milder in that it seems to allow that while reductionism is a “standard” scientific method it might admit other “non-standard” methodological approaches which are non-reductionist (e.g., emergence or holism). And while indigenous knowledge places “greater emphasis” on holistic approaches, this does not rule out placing some emphasis on non-holism. So, the Durie position is a qualified one with respect to reductive and non-reductive methods in science and in Mātauranga Māori; they are not fully exclusive. Here are further grounds for viewing the exclusivism of thesis (D3) in section 1 as not correct. Both holistic and non-holistic approaches can have their place in each of the methodologies of Mātauranga Māori and science.

There are two questions concerning holism and its rivals which need addressing; the first is to ask what advice should be given to scientists for directions of research, and the second asks what matters of a more metaphysical character should be adopted concerning the general structure of world in which we live. The first question is one a scientist might ask about the direction their research should take at any given time to solve problems: “should I adopt a holistic or a reductionist approach?” One answer might be to look at the past and ask which approach in this science has led to successful solutions to problems in the past – and then

adopt that approach. Another would be to consider the causal structure of the systems one is investigating; this might push one in the direction of a more holistic approach (but not one which necessarily invites one to ignore reductive considerations). Thus the general theory of relativity has a holistic aspect when it is applied to the cosmos as a whole, including the limit of the Big Bang.

The second question asks, of a pair of more or less completed theories, what relationship holds between them, and which theory is a more fundamental account of the world. Reductionism arises when one theory is shown to be a special case of the other thus reducing the number of independent theories to consider. There are a large number of accounts of the way in which one theory can be related to another. Not only are there many models of reductionism to consider but also many versions of rival models of emergence as well as models of holism, relationism, or systemism (the view of Mario Bunge), etc. Answering the question “which model fits best?” then becomes, not a matter of *a priori* pronouncement, but a matter of determining which model is best supported by the current state of the sciences. So an answer to both questions in the long run asks us to make scientific investigations. In the long run this scientific approach tends to support the accommodation of one theory to another rather than exclusion.

Science is a vast patchwork of different theories. Only when some model is applied to them can one ask grander questions about whether science supports, or does not support, materialism (or physicalism – see Stoljar 2010). Much research has gone into the interrelations of pairs of theories and the models they exemplify, only a little of which can be mentioned here. We can ask the following. What is the relationship of chemistry to Quantum Mechanics?²² Is it reductionist or holistic or a bit of both? (see Hettema 2017 who considers several models of reduction and Healy 2016 who advocates a limited role for holism). For the many who take a *structuralist realism* approach to the sciences (see Bokulich and Bokulich, 2011) at these levels, the dispute between reduction and holism simply drops away as irrelevant.

What is the relationship between genetics and biochemistry (see Sarkar 1998)? What is the relationship between body and mind (see Chalmers 1996)? What is the relationship of social facts to individual people (see Searle 1995 and Tuomela 2013)? In the last case a traditional theory of their relationship, characterised by methodological individualism as opposed to holism, is rejected in favour of quite new models which get beyond a simple reduction/holism dichotomy.

One may view issues concerning reduction and holism as either matters of the direction of current research or as a method of reducing the vast patchwork of scientific theorizing to obtain an overall metaphysical view of the world proposed in science. But understood either

²² Unfortunately Durie (2004: 12) does not find quantum chemistry a significant science because he lists it as ‘research not especially relevant to Māori (e.g. quantum chemistry)’. Often the discussion of Māori interests in science is restricted to a few sciences such as human health or environmental matters.

way, these issues of methodology fit best with the accommodation of Mātauranga Māori and science. They give no support to an exclusivist account of Mātauranga Māori.

6 Conclusion

In the two different editions of *Vision Mātauranga*, one can find, as we have pointed out, two different accounts of the relationship between Mātauranga Māori and science – accommodation and exclusion. Despite the fact that some form of exclusion seems to be the generally accepted account of the relationship between Mātauranga Māori and science, most of the recently published scientific papers are accommodationist. Exclusion claims not only that Mātauranga Māori and science are quite different bodies of “knowledge” (or more properly belief), but also that their respective principles of methodology are quite different. More plausibly, accommodation allows there to be many common elements within their body of “knowledge” and common principles of method (including proto-methods).

Does Mātauranga Māori say things that are correct? Despite the claims that they do, the relativist view of truth exclusionists adopt makes this hard to maintain. One needs scientific methods to show whether the claims of Mātauranga Māori are correct, or not; and this the accommodation readily facilitates. Moreover, we place all indigenous knowledge within the setting of the theory of evolution in which all humans in whatever society have evolved in such a way that they can bring their traditional beliefs to some argumentative tribunal. This is an ongoing process. What makes science and its methods distinctive in our current phase of the evolutionary process, is the reliability²³ which they have exhibited to produce truths. Accommodation is allied with this stance. In a contrary vein, exclusion makes Mātauranga Māori immune from criticism of the sort scientific testing can produce. In fact it makes Mātauranga Māori a supposed rival to science with its exclusionist claim that its tools of methodology are different.

Can there be an indigenous science? If this asks whether the claims of an indigenous body of belief can be scientifically tested, then accommodation says ‘yes’ while exclusion says ‘no’. But if this asks whether there is a distinct indigenous science, considered as a science complete with separate bodies of “knowledge” and methodologies, then accommodation says ‘no’ but exclusion could well endorse this. But it would do so at the cost of supposing that there were two kinds of science disparate from one another. There is but one science (albeit with application to different domains) with its methodological principles. There is not a host of them for each of the world’s various alleged indigenous “sciences” held by its respective indigenous society.

²³ For an introduction to reliabilist epistemology and methodology see Goldman and Beddor 2016.

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