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Ancient Wisdom and Future Medicine:
A Defense of the Science of Ayurveda

A Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Liberal Studies

by

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Heart disease, stroke, obesity, and diabetes are chasing modern humans to the grave. A month rarely passes without alarming news of the population's declining health. Ancient hunter–gatherers suffered from lifestyle diseases, too, but rarely. This started to change when our ancestors left plains and forests for farms and cities. Rates of these and other so-called diseases of civilization began to rise.[1] Many modern people, especially those in the West, have come to see these diseases as part of life.

Too many see these conditions as normal. They do not recognize the connection between lifestyle choices and poor health. They eat a lot of salty, sugary, highly processed foods. They get no regular exercise, and they do little to relieve stress. They smoke or drink more than they should. Sooner than their socio-economic status predicts, they succumb to a lifestyle disease.[2]

When they do, most in the West turn to modern medicine for solutions. The decline in their health took years, but they hope to find a quick fix, even if not an inexpensive or painless one. Their conventional family physician prescribes pills and procedures to ease their symptoms. The physician often fails to investigate their condition's potential causes, though. Physicians often fail to explore what roles diet,

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1. S. Boyd Eaton, Melvin Konner, and Marjorie Shostak, "Stone Agers in the Fast Lane: Chronic Degenerative Diseases in Evolutionary Perspective," *The American Journal of Medicine* 84, no. 4 (1988): 739–49, doi.org/10.1016/0002-9343(88)90113-1.

2. Andrea S. Wiley and John S. Allen, *Medical Anthropology: A Biocultural Approach* (New York, NY: Oxford University Press, 2017), 120.

exercise, and state of mind play in illness.[3] This treat-the-symptoms approach is common in the West. It also tends to minimize or ignore underlying causes of disease. Some Westerners have concluded that modern medicine offers only band-aids, not cures.

What is more, some wonder whether healthcare professionals have incentives *not* to heal. They wonder whether physicians knowingly prescribe ineffective or unnecessary pharmaceuticals or surgeries.[4] The treatment of acute illnesses and long-term diseases generates staggering revenues. In 2018, Americans spent about $3.65 trillion on healthcare, the most spent in the developed world.[5] Big pharma, medical supply companies, insurance companies, hospitals, and physicians benefitted. Patients, however, did not benefit so much from the boon. In the same year, the US ranked twenty-seventh in the world for overall health.[6]

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3. Jennifer Sinclair, Beverley Lawson, and Fred Burge, "Which Patients Receive Advice on Diet and Exercise? Do Certain Characteristics Affect Whether They Receive Such Advice?" *Canadian Family Physician • Le Médecin de Famille Canadien* 54 (2008): 406.

4. David Epstein and ProPublica, "An Epidemic of Unnecessary Treatment," *The Atlantic*, March 20, 2017, https://www.theatlantic.com/health/archive/2017/02/when-evidence-says-no-but-doctors-say-yes/517368/.

5. Erik Sherman, "U.S. Health Care Costs Skyrocketed to $3.65 Trillion in 2018," *Fortune*, February 21, 2019, https://fortune.com/2019/02/21/us-health-care-costs-2/.

6. Aria Bendix, "The US Was Once a Leader for Healthcare and Education - Now It Ranks 27th in the World," *Business Insider*, September 27, 2018, https://www.businessinsider.com/us-ranks-27th-for-healthcare-and-education-2018-9.

Some Westerners decide to look elsewhere for solutions to their chronic health problems. They turn to complementary or alternative approaches to conventional Western medicine.[7] Some people abandon conventional medicine altogether. They turn to alternatives, instead, such as chiropractic, homeopathy, and energy healing. Others who are dissatisfied with their conventional healthcare aim only to supplement it. They may give the latest trend in diet, exercise, or supplements a go. They may consult an herbalist and schedule regular sessions with a massage therapist. They remain under the care of a conventional physician, as well.

Some Westerners seeking unconventional solutions to chronic healthcare problems look to the East. Many of them explore traditional systems of medicine originating in China or India. A growing number look to Ayurveda as a complement, or even an alternative, to Western medicine.[8] Ayurveda is one of India's traditional systems of medicine.[9] Its history stretches back millennia, into the mists of Vedic antiquity.

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7. "Complementary, Alternative, or Integrative Health: What's in a Name?" *National Center for Complementary and Integrative Health*, April 2, 2019, https://nccih.nih.gov/health/integrative-health.

8. V. Sajeev Kumar, "Europe Fast Embracing Ayurveda alongside Modern Medicine," *The Hindu BusinessLine*, January 12, 2018, https://www.thehindubusinessline.com/news/variety/europe-fast-embracing-ayurveda-alongside-modern-medicine/article9481575.ece.

9. Ayurveda is not India's only traditional system of medicine (TSM). Unani and Siddha are, too, though neither plays so prominent a role. Further information is available at the website for India's Ministry of AYUSH: http://ayush.gov.in. AYUSH stands for Ayurveda, Yoga (and Naturopathy), Unani, Siddha, and Homoeopathy.

Though ancient, many view it as viable modern medicine. Generations of Indians have depended on its practitioners for advice, diagnosis, and treatment. Millions turn to Ayurveda, but what are they turning to? Are they relying on a bona fide medical science or on a patent medical pseudoscience?

The answer to that question must take four key prior questions into consideration. One, what criteria distinguish a genuine science from a pseudoscience? Two, how compatible with genuine science are Ayurveda's history and philosophy? Three, how compatible with genuine science are Ayurveda's methods, results, and research? Four, do significant, even determinative, differences exist among ancient, traditional, and modern "Ayurvedas"? Once these questions are answered, Ayurveda's scientific status will become clearer. "Clearer" does not mean settled. The East and West have different understandings of important terms in the discussion. Indian approaches to metaphysics, epistemology, and methods differ from those in the West. A brief paper cannot work through all such differences.

Still, answers to these three key questions will caution the critic. Answers will show that Ayurveda's modern expression ought not to be dismissed. It is neither outdated nor irrational. Evidence will support the claim that Ayurveda is maturing in, and because of, the modern age. The modern expression of Ayurveda is a genuine science with a promising future. Ancient and traditional approaches to Ayurveda may not be defensible as modern sciences. This thesis of this paper, though, assumes Ayurveda's *modern* expression. Thus, the Ayurveda being defended is one that values modern, Western

education. It values modern Western medicine, even while pointing out some of its shortcomings. This paper does not defend every Ayurvedic folk healer throughout the world.

THE PROBLEM OF DEFINING SCIENCE[10]

The claim that Ayurveda is a genuine science may stand or fall on the definition of *science*.[11] People use the term regularly enough. Defining it should be straightforward. In the early 1960s, many Americans thought the same thing about the term *obscenity*. In 1964, the Supreme Court handed down its ruling in the *Jacobellis v. Ohio* case. The case involved the questionable obscenity of Louis Malle's film *The Lovers*. In question was whether the film constituted hard-core pornography. The Court found that it did not meet the criteria.

Justice Potter Stewart was among the decision's majority opinion. He was reluctant to define hard-core pornography. Still, he denied that Malle's work crossed the

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10. Massimo Pigliucci and Maarten Boudry, ed., *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem* (Chicago: University of Chicago Press, 2013). This section is especially indebted to Pigliucci, Mahner, and Hansson for many general insights into the demarcation problem. Helpful, too, is Sven Ove Hansson, "Science and Pseudo-Science," *Stanford Encyclopedia of Philosophy*, April 11, 2017, https://plato.stanford.edu/entries/pseudo-science/.

11. This paper italicizes terms when discussing their definition or etymology.

line. Famously, he said of what he demurred from defining, "I know it when I see it."[12] Stewart might not have been able to define the sort of obscenity in question. He claimed to be able to recognize it when in front of him, though.

As Stewart felt about obscenity, many Americans feel about science. They believe they intuit what science is and can recognize it when they see it. Recent surveys reveal otherwise.[13] They reveal deep illiteracies about both the facts of nature and the methods of science. Advertising claims about "evidence-backed" or "scientifically proven" products add to the confusion. Op-ed columns and political statements from non-scientists do, too.[14]

Many non-scientists play fast and loose with the terms *science* and *scientific*. Professional scientists use the terms with frequency and ease, of course. Still, some might feel at a loss if asked to define them.[15] Intuiting the meaning of a crucial term may have sufficed in the *Jacobellis* case. Intuiting the meaning of *science* will not do as a sorting

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12. "Jacobellis v. Ohio," *Legal Information Institute*, accessed March 16, 2020, https://www.law.cornell.edu/supremecourt/text/378/184.

13. Henry I. Miller, "Scientifically Illiterate America," *Hoover Institution*, November 29, 2017, https://www.hoover.org/research/scientifically-illiterate-america.

14. Lawrence M. Krauss, "Trump's Anti-Science Campaign," *The New Yorker*, June 19, 2017, https://www.newyorker.com/news/news-desk/trumps-anti-science-campaign.

15. Miller, "Scientifically Illiterate America."

criterion for the purpose at hand. Evaluating whether Ayurveda is a genuine medical science requires conceptual boundaries.

A logical place to look for an answer is a dictionary, and there are many to choose from. One could compare and synthesize the entries for *science* in the most reputable of them. One could also select a leading reputable dictionary and then weigh its helpfulness. For the present illustration, this approach will prove sufficiently effective and more efficient. One such leading reputable dictionary is the *New Oxford American Dictionary*, 3d edition. It defines the term in this way. *Science* is "the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment."[16]

This seems to settle the issue until one considers a dictionary's limitations. Chief among them, a dictionary's definitions are descriptive, not prescriptive. That is, dictionaries do not provide authoritative and unchanging meanings of words. Rather, they provide dynamic descriptions of how terms are commonly used. Dictionaries show how speakers use terms in different contexts. As terms' uses change over time, a dictionary's entries change to reflect their evolution.

Clarifying a term's *meaning* in a particular context, though, is a different matter. A term can mean one thing in one setting and something else in another. This is true

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16. Angus Stevenson and Christine A. Lindeberg, *The New Oxford American Dictionary:* Third Edition (New York: Oxford University Press, 2010). Abbreviated as *NOAD* in subsequent footnotes.

about the term *science*, and it is true about all the words the dictionary uses to define *science*. Clarifying a term's meaning requires input from linguistics, psychology, and philosophy. Scrutinizing what the dictionary says about science answers some questions but prompts others.

What sort of "intellectual … activity" is science? Empirical and rational only or intuitive and imaginative, as well? Must science always and everywhere be a "practical" activity? Can a field's foundation not be observational but the rest of it only theoretical? Science studies "the structure and behavior of the physical and natural world." Does that imply that the only world that exists is one that is physical and natural? If science studies the "structure" of the world, does that mean that science reveals what *is*? Alternatively, does science merely create effective models to account for observational data? How can someone know which? Is science itself competent to say? The definition speaks of observation and experimentation as science's instrumental means. Are these reliable means of learning about the natural world? Are they the only two? How does someone know? One cannot intuit the semantic scope of *science*, nor can a dictionary settle the issue.

The problem of defining science proves even more complicated. To determine its semantic boundaries, one must know the contours of related concepts. Where do the

boundaries of pseudoscience and nonscience begin and end?[17] Could the definitions of *pseudoscience* and *nonscience* clarify what *science* is? Could one best define science in the negative, as the anti-pseudoscience and anti-nonscience? Or must one begin with the question of what science is to see how the others differ from it?[18]

Philosophers refer to this science-definitional conundrum as the demarcation problem. Philosopher of science Karl Popper (1902–94) was first to call attention to it. Many intractable issues surround discussions of demarcation. The preceding several paragraphs raise only a few. Doing the problem justice requires a book, and many scholars have taken up the challenge. One helpful contribution is *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*.[19] An introduction to the topic, such as this paper provides, can only scratch the surface.

Popper's basic question addresses a fundamental concern in the philosophy of science. Do criteria exist that can differentiate science from both pseudoscience and nonscience? How can one distinguish scientific claims from claims that merely purport to be? How can one distinguish scientific claims from those that do not purport to be

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17. The contours of protoscience are worth exploring, too, but not for the same reason. Protoscience differs from genuine science mostly by degree, not by kind.

18. This approach has prima facie plausibility. The terms *pseudoscience* and *nonscience* are back-formations of the term *science*. *Science*, that is, has lexical and semantic priority.

19. Massimo Pigliucci and Maarten Boudry, ed., *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem* (Chicago: University of Chicago Press, 2013).

scientific at all? Einstein's relativity and Freud's psychoanalysis make claims about the world. Wordsworth's poetry does, too.

Into which category—science, pseudoscience, or nonscience—does each belong? What sorting criteria does one use to decide? Solving the demarcation problem would permit the objective answering of these questions. It is important to note where demarcation focuses its efforts, though. Pondering what distinguishes poetic claims from scientific claims can prove fascinating. Such an investigation explores the boundary between science and nonscience. More relevant to the demarcation problem is what differentiates science from pseudoscience.

Popper argued that the distinguishing characteristic of scientific claims is their falsifiability. A scientific claim, that is, has the potential to be proven incorrect. A genuine science makes hypotheses or predictions that evidence can, in theory, refute. Claims that cannot be disproven—claims that are non-falsifiable—are not scientific. They are either nonscientific or pseudoscientific. Popper's falsificationism contrasts with the verificationist view of demarcation. According to verificationism, science makes claims that empirical evidence can, in theory, prove.[20] Following David Hume's insights,

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20. Jacqueline McLaughlin, "A Gentle Reminder That a Hypothesis Is Never Proven Correct, nor Is a Theory Ever Proven to Be True," *Books & Resources: NSTA WebNews Digest*, August 14, 2006, https://www.nsta.org/publications/news/story.aspx?id=52402. Popper and others refuted verificationism long ago. Science cannot prove hypotheses, theories, etc.; it can only support them. Verificationism's view of science has persisted, though, among scientists and nonscientists alike.

though, Popper denied that this was possible. Verificationism's proofs rest on logical induction, which has fatal inferential flaws.

Among them, induction attempts to justify universal claims with particular observations.[21] One may observe many instances of phenomenon P, all with characteristic C. It does not follow, however, that C holds for all possible instances of P. Further, one cannot know in fact whether C holds for every instance of P without observing each P. Without omniscience, this verification is impossible. A simple illustration from history will underscore the problem with inductive inference.

Medieval Europeans had seen swans for centuries, and all were white. Their use of induction led them to conclude that all swans are white. Problem was, their observations—like all observations—were limited to particular instances. Limited observations of a phenomenon cannot entail universal statements about that phenomenon.[22] Centuries later, Europeans discovered black swans in Australia. As the

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21. Stephen Phillips, "Epistemology in Classical Indian Philosophy," *Stanford Encyclopedia of Philosophy*, February 13, 2019, https://plato.stanford.edu/entries/epistemology-india/. The ancient Indian Cārvāka materialist school recognized induction's weaknesses, too. Induction rests on an inference from perceptual experience to the unexperienced. Making generalized claims about the unexperienced is unwarranted because it lacks empirical evidence. Striking about Cārvāka's insights is that they predate Hume's by more than 2,000 years.

22. Under one condition, limited observations can entail universal statements. The condition is that the limited observations happen to include all instances of P. In this case, induction's problem becomes less one of logic, more one of epistemology. Observers cannot *know* whether they have observed all instances of a phenomenon.

illustration shows, verification fails as science's demarcation criterion. It relies on an unreliable logical foundation.

Popper's criterion of falsifiability rests on a different logic, the hypothetico-deductive method. Falsifiability's logic moves from a hypothetical premise to a (hypothetically) certain conclusion. If X is a sufficient cause of Y, then whenever X is present, Y will be, too. What can we conclude, then, if data from many experiments often show X but no Y? First, we conclude that the data disprove the hypothesis. X is not a sufficient cause of Y.

The second conclusion we draw is a key feature of the falsifiability doctrine. According to Popper, a disproven hypothesis does not reveal a failure of science. It shows that a proper science is at work. However counterintuitive, the disproving of a hypothesis demonstrates the essence of science. Science makes testable claims that specific empirical evidence, if found, can refute. This, Popper claimed, is the criterion that separates genuine science from all pretenders.

Many philosophers and scientists find both verificationism and falsificationism inadequate lines of demarcation. They agree with Popper's criticism of verificationism, while not embracing his solution. Some, such as science historian Michael Shermer, challenge falsificationism's starting point. They agree that generating and testing hypotheses fits well with some scientific disciplines. They deny that this method fits well

with all scientific endeavors.[23] Shermer points to string theory and the extraterrestrial hypothesis as examples.[24] (Some challenge whether these examples are themselves scientific.) A simple, noncontroversial illustration can convey Shermer's concern equally well.

A biochemist combines compounds to see what effect the result has on cancer cells. Such an approach need not begin with, or ever produce, a clear if–then hypothesis. Instead, the researcher might pose a series of open-ended questions of scientific exploration. "I wonder what will happen when I … ?" The results of such experimentation may be only observation, analysis, and recommendations. It may show the researcher whether a line of cancer research is worth the pursuit. This sort of scientific exploration need not end in the support or refutation of a claim, though. The requirement that genuine science makes falsifiable claims is too narrow a constraint.

Others see a different problem with viewing falsifiability as science's defining characteristic. It allows patent pseudosciences to be classified as scientific. Astrology, phrenology, and homeopathy are prime examples. All make falsifiable claims, claims that

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23. Ashutosh Jogalekar, "Falsification and Its Discontents," *Scientific American Blog Network*, January 24, 2014, https://blogs.scientificamerican.com/the-curious-wavefunction/falsification-and-its-discontents/.

24. Michael Shermer, "What Is Pseudoscience?" *Scientific American*, September 1, 2011, https://www.scientificamerican.com/article/what-is-pseudoscience/.

empirical evidence can, in theory, refute. According to Popper's model, we may view them as genuine scientific endeavors.

The problem with classifying them as such is that all make claims that have been proven false.[25] Evidence has disproven both particular hypotheses of these pseudosciences and their theoretical foundations. Of course, even mainstream biology, chemistry, and physics make claims that prove false. While true, pseudoscience and genuine science respond to falsification in different ways. A genuine science abandons a failed hypothesis because refuted by empirical evidence. A pseudoscience, by contrast, often modifies the hypothesis to accommodate confounding evidence. An excellent example is genuine science's challenge to homeopathic preparations.

Homeopathy adds a purported medicinal agent to water.[26] The mixture is then "activated" by diluting it thousands of times. Chemists have pointed out a significant problem with these dilutions. None of the original medicinal agent survives the process. Skirting the apparent falsification, homeopathy modifies its claim. A homeopathic

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25. Tania Lombrozo, "What Is Pseudoscience?" *NPR*, May 8, 2017, https://www.npr.org/sections/13.7/2017/05/08/527354190/what-is-pseudoscience.

26. Homeopathy (from Gk. for "like/similar + sickness/disorder") owes its name to how it treats sickness. Conventional medicine identifies a pathogenic cause of sickness and then counteracts its effects. If harmful bacteria are the cause of illness, then it prescribes an antibiotic. By contrast, homeopathy does not treat sickness with countermeasures. Instead, it treats a pathogen or sickness with an agent that causes similar symptoms. Homeopathic theory claims that like cures like—pathogen defeats pathogen, as it were. Though not a defense of homeopathy, biomedical vaccinations work on the same principle.

preparation's mechanism of action is not in the medicinal agent. It is in the dilution water, which retains the "memory" of the medicinal agent no longer in it. One should not consider it any more scientific than the refuted claim it replaces. Contra Popper, falsifiability is too broad a criterion to distinguish science from pseudoscience.

As demarcation candidates, verificationism and falsificationism focus on science's relationship to claims. One says that science proves them; the other, that science disproves them. Some philosophers see essential definitions as better approaches to the demarcation problem. They frame the discussion as a more fundamental question: what *is* science? Once science is defined, it can be distinguished from what merely purports to be.

This approach is not the effortless consulting and comparing of reputable dictionaries' entries. It does not attempt to ascertain the most common uses of the term *science*, either. Instead, the essential-definition approach is self-consciously prescriptive, not descriptive. It makes lists of characteristics that render a field, claim, or community scientific. The characteristics tend to focus on empirical methods and epistemic warrant. On the lists appear qualities like "observation-based," "replicable," "evidence-directed," "probabilistic," and "cause-seeking." Essential definitions sound promising, but they tend to have significant shortcomings.

The first is that some essential definitions exclude fields most recognize as scientific. If hypotheses need to be lab-testable and their results reproducible, what about cosmology? How does one conduct and replicate experiments that show how the universe

came to be? How does one replicate the conditions of the primal universe, of its first few seconds? Physical conditions were vastly different then from what they have been since. Physical processes operated by (or, at least, within) a different set of rules. What about the claims of string theory or the multiverse hypothesis?

An essential definition can broaden to suit more hypothetical/theoretical fields, of course. Such adjustments can prove problematic, though. They can lead to a second potential defect of essential definitions. Some could legitimate fields, claims, and communities that most scientists view as pseudoscientific. Certain definitional lists would qualify cryptozoology, ufology, and panspermia as genuine sciences.

The third defect of essential definitions is the most problematic. No authoritative science-definitional list exists. It exists neither among scientists nor among philosophers of science. Different experts view different characteristics as necessary to the essence of science. Some require that scientific claims be peer-reviewed, and some do not. A simple illustration can show how this common feature of modern science can be arguable.

Does any philosopher or scientist question whether Isaac Newton was a scientist?[27] Was his work peer-reviewed, though? Did a contemporaneous community of scholars critique all his work? Did teams of fellow astronomer–physicists recreate his experiments, rework his math? If not, can his work be considered scientific? Can he be

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27. Newton considered himself not a scientist, but a natural philosopher. This point is irrelevant, though, for the current discussion—whether genuine science requires peer review.

considered a scientist? Some of Newton's contemporaries interacted with his ideas. The interaction hardly constituted a scholarly scrutinizing by a global community of peers. Still, who argues that Newton was not doing science?

Some thinkers see as essential to science one or more qualities that others dismiss. Others disagree over whether certain characteristics are jointly sufficient to define science. One philosopher claims that her list of characteristics is sufficient to define it. Another philosopher strikes two qualities from her list and adds three more of his own. Proposed essential definitions sometimes overlap, but no unified, incontestable description has arisen. This definitional ambiguity leads to further disagreements when assessing a claim's scientific standing.

Whose definition should the scientific community use when evaluating a controverted field? Evolutionary psychology, for example, aligns with some, but not all, essential-definitional lists. Is it a science, and on what grounds does one say so? Whose essential-definitional list is the standard by which its claims are judged? Essential definitions address some of the weaknesses of other approaches to demarcation. They create their own complex problems, however.

Falsification, verification, and essential definitions fail as solutions to the demarcation problem.[28] No framing of these approaches garners the consensus of all

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28. Thomas Nickles, "History and Future," in *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*, ed. Massimo Pigliucci and Maarten Boudry (Chicago: University of Chicago Press, 2013), 1928–2353 (Kindle edition).

philosophers and scientists. Philosopher Massimo Pigliucci underscores how much of a conundrum demarcation is. "The boundaries separating science, nonscience, and pseudoscience are much fuzzier and more permeable than Popper (or, for that matter, most scientists) would have us believe."[29] Science's boundaries are more like a chain-link fence than a concrete wall. Wherever the fence is placed and however tight its mesh, one can count on two outcomes. Something desirable will be excluded, and something unexpected will get through. What is more, the demarcating fence is susceptible to being moved. Where today's thinkers place it, tomorrow's thinkers may upend.

Some maintain that the boundary problem is even worse than the fence image suggests. Philosopher Larry Laudan concludes that the entire demarcation project may be futile. He finds the question "both uninteresting and, judging by its checkered past, intractable . . . . We ought to drop terms like 'pseudo-science' and 'unscientific' from our vocabulary; they are just hollow phrases which do only emotive work for us."[30] Some uses of the terms *unscientific* and *pseudoscientific* may be shallow and subjective. Some demarcation solutions may be little more than self-serving turf protection, too.

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29. Massimo Pigliucci, *Nonsense on Stilts: How to Tell Science from Bunk* (Chicago: The University of Chicago Press, 2010), quoted in Michael Shermer, "What Is Pseudoscience?" *Scientific American*, September 1, 2011, https://www.scientificamerican.com/article/what-is-pseudoscience/.

30. L. Laudan, "The Demise of the Demarcation Problem," in *Physics, Philosophy and Psychoanalysis: Essays in Honor of Adolf Grünbaum* (Vol. 76 of Boston Studies in the Philosophy of Science), ed. R. S. Cohen and L. Laudan. (Boston: D. Reidel, 1983), 125.

Shermer agrees. “The boundary problem between science and pseudoscience, in fact, is notoriously fraught with definitional disagreements because the categories are too broad and fuzzy on the edges, and the term ‘pseudoscience’ is subject to adjectival abuse against any claim one happens to dislike for any reason.”[31] Some use the term more as (subjective) pejorative than as (objective) classification. Labeling something “unscientific” or “pseudoscientific” may reveal much about someone’s biases. It may reveal little about what makes science, science. Laudan and Shermer make sound, cautionary points.

Still, their observations do not make the demarcation effort impossible. Ask educated people whether physics and astrology are sciences. They may not label one as science and the other as pseudoscience. Nor, likely, will they say anything about boundary criteria. Nonetheless, they will recognize physics as scientific and astrology as something else. They will intuit one or more key differences, even if unable to identify them with precision.

The critic may protest that this illustration uses extreme examples. Anyone can distinguish an obvious science from an obvious pseudoscience. The demarcation problem, the critic maintains, lies nearer the boundary between the categories. This is a valid concern, but it concedes the point that demarcation is possible. People can distinguish a genuine science from a field that only purports to be. This does not imply

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31. Shermer, “What Is Pseudoscience?”

that they always sort correctly, nor that they use a sound method for sorting. Nor does it imply that people's categories are not sometimes fuzzy around the edges. People do have the ability, though, to differentiate a sham or a superstition from a science.

Attempting to distinguish science from pseudoscience is not always pointless, either. Sometimes, it helps people stay out of harm's way. An increasing number of claims purport to be evidence-based, lab-tested, or research-confirmed. Touting a claim to be scientific, even if unsubstantiated, gives it an air of credibility. In some areas, a person's belief in a pseudoscientific claim has little practical effect. What harm is done when someone attributes her stress relief to vibrating crystals? What does it matter that a couple of Himalayan hikers claim to have seen a yeti?

In other areas, such as healthcare, believing in a sham science can have dire consequences. Relying on aromatherapy to cure cancer or homeopathy to cure Ebola could prove fatal. This is why investigating Ayurveda's scientific standing is important. How does one do that, though, if common demarcation solutions have been ruled out? What approach can garner enough agreement to be an effective boundary criterion?

One robust and helpful approach to demarcation is to think of *science* as a cluster concept. A cluster concept is an idea best described by means of connected attributes. These attributes are not like essential definitions' necessary and sufficient characteristics, though. With a cluster concept, no attribute is always necessary to describe it. There may be rare situations in which common attribute Z, for example, does not apply. Nor is any combination of attributes always sufficient to describe a cluster concept. Under some

conditions, attributes A, B, and C will be enough to identify the concept in question. Under other conditions, attributes B, C, and D will suffice.

Cluster concepts differ from essential definitions in another important way. Cluster concepts do not allow for either–or evaluation. Taking a definitional approach, a field or claim either is or is not scientific. The field or claim either meets the definitional threshold, or it does not. Cluster concepts, in contrast, are not semantic binaries. Rather, these terms' descriptions represent a range of qualitative possibilities. Evaluating a term as a cluster concept yields semantic probabilities, not certainties. The more concept X descriptors we can attribute to an undetermined Y, the more likely Y is to be an instance of X.

As illustration, someone would like to know what a *family* is. She wants to know what demarcates a genuine family from a non-family or a family falsely so called. The dictionary tells us that a family is "a group of people related to one another by blood or marriage."[32] This captures a common use of the term, but it says at the same time too much and too little. The definition allows, in principle, for an unlimited number of family connections. If Q and R are distant family members and R and S are, too, then Q and S are themselves distant family members. What is more, this applies to all combinations of Q's, R's, and S's relatives, present and past. With so many "family" relationships, the term loses its distinctness and usefulness. The dictionary's definition says too little, as

32. Stevenson and Lindeberg, ed., *NOAD*.

well. Where do adoptive families fit, for example? Adopted children have no biological or marital connection to their adopting parents.

The dictionary cannot serve as a comprehensive, authoritative demarcator of *family*. An essential definition would fare no better. Both approaches run into the same sort of problems as when attempting to define *science*. A better way to understand the term *family* is to view it as a cluster concept. The term appears in different contexts, and each context can change its meaning. Still, each use of the term shares important conceptual attributes with all other uses of it. The more familial attributes a group of people shares, the more likely it is to be a family.

The cluster-concept method can help distinguish genuine sciences from pseudosciences. Approaching the problem this way aims to describe science, not define it. It also aims to say that an undetermined claim or field X either is likely or is not likely to be scientific. Science philosopher Martin Mahner takes this approach. To assess the scientific standing of some claim, field, or community, he asks a series of questions. The questions arise from a modern Western understanding of science. A few address psychological or sociological concerns. Most focus on epistemic justification or empirical methods. Most, that is, address the justification for a belief and how the belief was arrived at. Mahner's questions are illustrative rather than comprehensive, indicative rather than determinative. Still, how a claim, field, or community answers them shows how likely it is to belong to science's family.

> Do they form a research community, or are they just a loose collection of individuals doing their own thing?[33] Is there an extensive mutual exchange of information, or is there just an authority figure passing on his doctrines to his followers? Is the given group of people free to research and publish whatever they want, or are they censored by the reigning ideology of the society they live in . . . ?[34] Does the domain of study consist of concrete objects, or does it contain fuzzy "energies" or "vibrations," if not ghosts or other spiritual entities?[35] What are the philosophical background assumptions of the given field?[36] Does its ontology presuppose a natural, causal, and lawful world only, or does it also admit supernatural entities or events?[37] . . . Does it accept the canons of valid and rational reasoning? Do the principles of noncircularity and noncontradiction matter? Does it admit fallibilism or endorse dogmatism? Occam's razor or unfettered speculation? How important are testability and criticism? How important is evidential support?[38] Can the reliability of its methods or techniques be independently tested? Do the theories have genuine explanatory or

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33. History provides many examples of pioneer scientists who tended to work alone. They worked alone because they were opening a new field of scientific discovery. A research community in that field did not yet exist. Examples include the early modern astronomers Copernicus, Brahe, and Kepler.

34. This does not address the scientific standing of the community in question per se. The Nazis censored research that did not conform to their ideology. This does not entail that suppressed researchers were not conducting genuine science.

35. More precisely, this question asks whether the claim in consideration posits metaphysical causality. Genuine science may investigate whether evidence substantiates the existence of ghosts.

36. This question should be taken to mean current, not historical, philosophical assumptions. Many modern sciences were born in historical contexts that made unscientific/pre-scientific assumptions.

37. The real question here is not whether a community in question believes in a god. The question is whether that community attributes physical causality to a metaphysical entity.

38. This is an important question, of course. A more important question may be "What counts as evidence to justify, or support, a claim?"

> predictive power, or both? Are the theories fruitful?[39] Are the data reproducible? Are there mechanisms of error elimination? Are its claims compatible with well-established knowledge, in particular law statements? Does the field borrow knowledge and methods from adjacent fields? Does it in turn inform and enrich neighboring fields, or is it isolated? Do the problems tackled in the field spring naturally from research or theory construction, or are the problems pulled out of a hat? Is the corpus of knowledge of the given field up to date and well confirmed, or is it obsolete, if not anachronistic? Is it growing or stagnating?[40]

How Mahner words his questions points them toward his view of the "right" answers.[41] That is, his questions' substance and phrasing reveal how he understands science. Still, he does not suggest that all genuine sciences answer each question in the way he hints they should. Answers may differ here and there in details, but they will have much in common at their core. None of Mahner's questions is overwhelmingly more important than the others, either. Nor are all the implied right answers, taken together, sufficient to define science. The more a field looks like the family of implied right answers, though, the likelier it is to be science. Genuine sciences will share many family resemblances that pseudosciences lack.

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39. Here Mahner asks whether the field's theories give birth to further research.

40. Martin Mahner, "Science and Pseudoscience: How to Demarcate after the (Alleged) Demise of the Demarcation Problem," in *Philosophy of Pseudoscience*, ed. Massimo Pigliucci and Maarten Boudry (Chicago: University of Chicago Press, 2013), 752–77 (Kindle edition).

41. One might point out that Mahner's implied "right" answers beg the question at hand. "Right" answers *assume* a definition of science, which the cluster sets out to establish.

Mahner's family-resemblance questions can help us consider the claims of Ayurveda. The answers it gives, taken individually or as a whole, may not determine whether it is scientific. Cluster concepts are not essential definitions, and they offer only probabilities, not certainties. Still, how Ayurveda answers will provide a strong indication of its scientific standing. Ayurveda is a broad and deep topic. Its history, philosophy, diagnostics, therapeutics, research, and sociology are complex. Examining any aspect of Ayurveda could produce its own book.

The discussion below is limited. It will focus on Ayurveda's philosophical framework, clinical practice, and research methods. This focus cannot provide a full-orbed view of Ayurveda. It can, though, provide sufficient evidence to argue that Ayurveda is a member of science's family.

FOUNDATIONS: HISTORICAL, PHILOSOPHICAL, THEORETICAL[42]

Ayurveda is Sanskrit for "knowledge of life."[43] For centuries, millions have viewed it as a heaven-sent system of healing arts. Systematized Ayurveda may date only

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42. For this section, I borrowed from many sources. Payyappallimana and Venkatasubramanian were of special help.

43. Jivananda Vidyasagara Bhattacharya, *Shabda-Sagara, or a Comprehensive Sanskrit-English Lexicon Chiefly Based on Prof. Horace Hayman Wilsons Sanskrit-English Dictionary*, version: scan (Calcutta: Ashu Bodha Bhattacharya and Nitya Bodha Bhattacharya, 1900), https://www.sanskrit-lexicon.uni-

to the first few centuries CE. Its roots, though, stretch much further back. Tradition says that the god Brahmā revealed this knowledge of life to ancient sages.[44] They in turn preserved these insights in the Vedas. The Vedas are collections of sacred Hindu texts written approximately 1500–500 BCE.

In the centuries that followed, a class of healers called *vaidyas* emerged.[45] These were the first of those later called Ayurvedic practitioners or Ayurvedic physicians. Early systematized Ayurveda (c. 500 BCE–c. 500 CE) did not develop in a worldview vacuum. Growing in influence at the same time was *Sāṅkhya*, one of six "orthodox" (*āstika*) schools of Hindu philosophy.[46] Sāṅkhya may have shaped Ayurveda's philosophical

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koeln.de/scans/SHSScan/2020/web/webtc/servepdf.php?page=097-a. Ayurveda is a compound formed from *ayus*, "life," and *vēda*, "knowledge." Many Sanskrit terms will appear in the discussion that follows. Unless otherwise indicated, translations will come from the *Shabda-Sagara*. Sanskrit, one of India's most ancient languages, is the language of classical Ayurveda. Many key Ayurvedic terms are still considered foreign—i.e., not part of standard English. This paper will italicize foreign terms only when introducing or translating them.

44. Yogini S. Jaiswal and Leonard L. Williams, "A Glimpse of Ayurveda – The Forgotten History and Principles of Indian Traditional Medicine," *Journal of Traditional and Complementary Medicine* 7 no. 1 (2017): 50–53, doi:10.1016/j.jtcme.2016.02.002.

45. *Vaidya* is Sanskrit for "physician." Sanskrit and English inflect their vocabularies differently. For ease of use, though, this paper inflects Sanskrit as though English. The plural of *vaidya* will appear as *vaidyas*.

46. Cārvāka, one of Indian philosophy's "unorthodox" (*nāstika*) schools, did not view inference (from the perceived to the unperceived) as a valid means of knowledge.

foundation more than any other school.[47] A comprehensive system of thought, its doctrines address metaphysics, ethics, and epistemology. Most relevant to Ayurveda are the school's views on the natures of knowledge and reality.

Important to note first is how Sāṅkhya's rationalist epistemology influenced Ayurveda. Indologist–philosopher Ferenc Ruzsa summarizes the school's doctrine. "Sāṅkhya recognizes only three valid sources of information: perception, inference and reliable tradition. The ordering is important: we use inference only when perception is impossible, and only if both are silent do we accept tradition."[48] Traditional authorities, such as the Vedas, can be trusted as a source of knowledge. The principal sources of knowledge, though, are experience and reason.

Early vaidyas incorporated Sāṅkhya's epistemology into their medical practice. It provided an empirical framework for their diagnostics and therapeutics. They observed and compared the signs and symptoms of health and disease. They made inferences about the causes of each. Then, they designed systems of disease-prevention, diagnosis, and treatment based on those conclusions. Ayurveda researcher Christian Kessler, MD, et al. emphasize the value of the vaidyas' early scientific methods. "(Proto)scientific concepts

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47. Some argue that Nyāya exercised a greater influence on Ayurveda. Exploring the argument would take the present discussion far afield. What is most relevant about the present discussion is Ayurveda's metaphysics and epistemology. On these points, the Nyāya and Sāṅkhya schools are in sufficient agreement.

48. Ferenc Ruzsa, "Sankhya," *Internet Encyclopedia of Philosophy*, accessed March 17, 2020, https://www.iep.utm.edu/sankhya/.

have had a firm place in mainstream Ayurvedic medicine ever since around the beginning of the common era . . . and are centered around designated disciplines of logic and methodology."[49] The vaidyas often turned to the Vedas for inspiration, insight, and instruction. They turned first to sensory information, logical implication, and material causality.

Vaidyas studied what the Vedas have to say about healthy bodies and healthy living. They also observed and made inferences about the health of humans and other animals. How do creatures remain strong and sickness-free? How do they treat themselves when ill? Apparent cures observed by a vaidya might become subjects of rudimentary, small-scale experiments.[50]

One can imagine an illustrative scenario. A monkey eats a rotten egg and gets sick. In response, she gathers a handful of leaves from a tree she never uses for food. She seems to know (expects, at least) that the particular tree's leaves will have a healing effect. She swallows the leaves, nurses her belly, and vomits on occasion. Within a few hours, the monkey appears normal again. The vaidya wonders whether the leaves will

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49. C. Kessler et al., "Ayurveda: Between Religion, Spirituality, and Medicine," *Evidence-Based Complementary and Alternative Medicine* 2013 (2013): 1–11, https://doi.org/10.1155/2013/952432.

50. Experimentation may seem a surprising feature of early-CE Indian civilization. It was a logical result, though, of prevailing schools of philosophy. Several schools placed the highest epistemic value on direct perception of phenomena. In these schools, comparisons, inferences, and authorities played secondary roles at best. If perception is paramount, then experiments are efficient ways to expand its reach.

have the same effect on humans. He administers some to a villager made sick by eating rotten food and observes what happens.[51] If the treatment works, he makes a mental note of his findings as a future prescription for the ailment.[52]

He considers other animal cures and folk remedies, too, and seeks to validate them. He shares his findings with students and other healers. Other vaidyas share their observations and inferences, as well. The oral tradition that emerges spreads knowledge about health and disease. This collective wisdom becomes a sort of diagnostic and therapeutic manual for vaidyas. How can people remain healthy? What are various ways they can get sick, and how should a vaidya treat them? The knowledge and methods of these early healers becomes the foundation of Ayurveda.[53]

During the first millennium BCE, two vaidyas stand out: Suśruta (c. 600) and Charaka (c. 250).[54] Like other early vaidyas, they studied the Vedas. They observed how

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51. The pronoun "he" is used for the ancient vaidya only for historical purposes.

52. The vaidya concluded that what worked in one instance will work in others. The use of this type of reasoning was a point of contention among early Indian philosophies. Critics, such as the Cārvāka school, pointed out a problem with induction. It draws conclusions based not on sensory input, but on something *not* perceived. The vaidya observed a cure in one villager's instance. He then drew a conclusion about others whom he had not yet observed.

53. "Journey of Ayurveda," *YouTube*, accessed March 17, 2020, 15 min. mark, https://youtu.be/1y5VhRDM6QU.

54. Estimates for Suśruta's and Charaka's lifespans vary widely. What complicates matters is that works attributed to one or both may be synthetic. They may owe to an original author, disciples' modifications, and later redactions. This paragraph

humans and other animals maintain health. They attempted to validate apparent cures for various ailments. They studied other vaidyas' work, too, seeking to confirm their findings.[55] Unlike earlier healers, they aimed to codify and comment on all that was known about health. Suśruta focused on surgery; Charaka, on the causes, symptoms, and cures of disease. They compiled their knowledge into compendia known as the *Suśruta Saṃhitā* and the *Charaka Saṃhitā*.[56] Many regard these as the bibles of Ayurveda and their authors as the fathers of Indian medicine. Between them, the texts outline eight medical specialties. They are internal medicine, otorhinolaryngology, pediatrics, psychiatry, rejuvenation, surgery, toxicology, and virilification.[57]

The *Suśruta Saṃhitā*, *Charaka Saṃhitā*, and other early Ayurvedic texts have much to say about human health and sickness. They also have much to say about human nature itself. Ayurveda's perspective on the subject owes much to Sāṅkhya's metaphysical dualism. Sāṅkhya views human beings as part *prakriti*, part *puruṣa*. *Puruṣa*

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eliminates timeline and authorship ambiguity for simplicity's sake. Admittedly, historical accuracy may suffer.

55. In most instances, other vaidyas' experiences were captured only in oral tradition/accounts.

56. A *saṃhitā* is a collection of post-Vedic texts.

57. Gopi Warrier, *Ayurveda: The Right Way to Live* (London: Carlton, 2002), 11. Virilification is the "use of aphrodisiacs and fertility-boosting agents to improve sexual function and generative issues."

can be understood as "person," "soul," "consciousness," or "self."[58] It is the immaterial principle that infuses humans with personality and uniqueness. *Prakriti*, by contrast, is the set of physical constituents that make up a human being. Prakriti is the sum total of a person's material existence.

Anything about a person that may be seen, heard, touched, tasted, or smelled is a product of prakriti. So are the mental faculties that allow humans to interpret such sensory information. Perception and reason, that is, also arise from prakriti, not puruṣa. Puruṣa "is pure consciousness: it enjoys and witnesses Prakṛti's activities, but does not cause them."[59] Most striking about Sāṅkhya's metaphysical dualism is the profound inactivity of puruṣa. Ruzsa emphasizes the point:

> It is a notable feature of Sāṅkhya that its dualism is somewhat unbalanced: if we dropped *puruṣa* from the picture, we would still have a fairly complete picture of the world, as *Prakṛti* is not inert, mechanical matter but is a living, creative principle that has all the resources to produce from itself the human mind and intellect. Sāṅkhya thus looks like a full materialist account of the world, with the passive, unchanging principle of consciousness added almost as an afterthought.[60]

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58. The literal Sanskrit meaning of *puruṣa* (sometimes transliterated *purusha*) is "man." In Sāṅkhya philosophy, though, as Ruzsa explains, "it often is used for the wider concept of person."

59. Ruzsa, "Sankhya."

60. Ruzsa, "Sankhya."

It is this "unbalanced" dualism that shaped Ayurveda's understanding of human nature. Vaidyas saw the causes of human health and sickness as material and sensate. They viewed the proper treatment of illness to be material and sensate, as well. A modern physician may point out that they knew little about the actual causes of sickness. Early Indian healers knew nothing about bacteria, viruses, parasites, and prions. Still, vaidyas embraced the idea that material causes account for material effects.

They sought to explain human health and sickness in terms of the only material agents they knew. To an ancient vaidya, these material agents were earth, water, fire, air, and space.[61] Ayurveda refers to them as the *pancamahabhutas*, the five fundamental, or "great," elements. All natural things—that is, all things with a prakriti, a material nature—are made of them. Human beings are puruṣa–prakriti composites. The puruṣa, having no material existence, is not a product of the five elements. It is a preternatural entity. Only the prakriti is deemed to arise from the natural elements.

In humans, the pancamahabhutas combine to form the *doshas*. A dosha is one of three basic bodily humors: *vata*, *pitta*, and *kapha*.[62] The original meaning of the Sanskrit *dosha* had scant connection to a bodily humor. Pre-Ayurvedic use of the term often

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61. These "classical elements" appear in early Western metaphysics, as well.

62. Most today pronounce the ph in "kapha" as /f/. In ancient Sanskrit, it would have sounded like a breathier, more plosive /p/. Early Western medicine had a similar belief in basic bodily humors. Hippocrates referred to them as blood, yellow bile, phlegm and black bile.

pointed, instead, to a fault, defect, or blemish.[63] Early vaidyas began to use the term to refer to "fault lines" in the body's health.[64] In this early sense, the doshas were where a defect in human health—a disease—could occur. When vata, pitta, and kapha are in balance, humans remain healthy. When diet, activity, emotional state, or environment becomes unbalanced, however, people become sick.[65]

Doshas regulate all systems of body and mind, from gross-motor movement to imagination.[66] Like the pancamahabhutas, the doshas are understood to be material entities. They are not *new* material entities, but arrangements of the five basic elements. Vata dosha blends air and space, and classical Ayurveda links it to bodily movement. Vata regulates locomotion, as well as respiration and blood circulation. Pitta is the fire dosha, and it is linked to metabolism and the digestive and endocrine systems. Kapha dosha blends the elements of earth and water, and Ayurveda links it to chest, torso, and back. Kapha regulates growth and strength.

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63. *Shabda-Sagara*, "doṣa."

64. Robert Svoboda in *Doctor from India*, directed by Jeremy Frindel (New York: Kino Lorber, 2018), https://www.kanopy.com/product/doctor-india.

65. Marc Lallanilla, "Ayurveda: Facts About Ayurvedic Medicine," *LiveScience*, January 7, 2015, http://www.livescience.com/42153-ayurveda.html.

66. Many Ayurvedic practitioners would protest this sentence's Cartesian mind–body dualism. They would argue that body and mind are not the human being's bipartite constituents. Nature and consciousness are. Under the head *nature* fall all aspects of human psychology and anatomy/physiology.

Ayurveda sees the doshas as more than human beings' material causes, though. The doshas' permutations and combinations also constitute psycho-physical human types. Pitta is not only the fire-dosha, for example. It is also represents a particular anatomical, physiological, and psychological makeup.[67] When a vaidya says that a person has a pitta constitution, it means that pitta dosha predominates. Doshic types may be single-dosha or dual-dosha dominant. Someone's doshic type, then, may be vata only, pitta only, kapha only, vata–pitta, pitta–kapha, or vata–kapha.[68] Everyone fits into one of these six general doshic categories.

Sorting people by doshic type has analogs in the West. Westerners often sort people using physical and psychological criteria. For example, an exercise physiologist might classify clients according to body type. She might see clients as ectomorphic, mesomorphic, or endomorphic. The mesomorphs will have "a compact and muscular body build."[69] She will use the term *mesomorph* as shorthand for a set of anatomical features.

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67. Unnikrishnan Payyappallimana and Padma Venkatasubramanian, "Exploring Ayurvedic Knowledge on Food and Health for Providing Innovative Solutions to Contemporary Healthcare," *Frontiers in Public Health* 4, no. 57 (2016), doi:10.3389/fpubh.2016.00057. Some Ayurveda researchers link doshic types to discrete phenotypes. See Periyasamy Govindaraj et al., "Genome-Wide Analysis Correlates *Ayurveda Prakriti*," *Nature News* 5, 5786 (2015): 1–12, doi:10.1038/srep15786.

68. Ayurveda outlines doshic subcategories, as well, but their discussion is not relevant here.

69. Stevenson and Lindeberg, ed., *NOAD*.

Psychologists often sort people, too, but according to personality type. They view people as either more introverted or more extroverted. Some are concerned more about their own thoughts and feelings. Others are concerned more about external things or objective considerations. Both terms, introvert and extrovert, represent a complex of psycho-emotional and psycho-social characteristics. Combining body–mind classifications, some people are introverted mesomorphs. Body and personality typing are convenient ways to convey information about someone.[70]

The six doshic types play a similar role in Ayurveda. They summarize common features of categories of human beings. All human beings share many characteristics. Those of the same doshic type share even more. Still, no two human beings ever have identical physical and psychological constitutions. No two bodies, no two minds work exactly alike, not even in twins. Each human being has his or her own unique prakriti, and that prakriti determines his or her doshic type. Even within the same doshic type, though, people's psycho-physical makeups vary. Among vata–kaphas, for example, some are more vata dominant, some more kapha.

When people live compatibly with their doshic type, they remain healthy longer. Their psycho-physical constitution is in equilibrium. People rarely live in harmony with their doshas, though. They eat what they ought not to and do not sleep as they should. They get too much physical activity or too little, and they deal with stress poorly. They

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70. They are convenient. They are not always so precise as a physician or scientist might like.

live in geographies or climates unsuited to their constitutions. Those with pitta dosha, for example, should reduce or avoid hot and spicy foods.[71] Most people on the planet, however, know nothing of their doshic type. Ignorant of Ayurveda's advice, many pittas routinely eat hot and spicy meals. Soon, many develop acid reflux and other digestive difficulties. The added heat in their diet—thermal and chemical—cause a pitta imbalance.

When people live incompatibly with their doshic type, they are more likely to become ill. Various factors, some controllable and some not, affect the balance of individuals' doshas. A change in one's doshic balance results in a change in one's physical or mental well-being. Ayurveda calls a person's present state of health, whatever it is, his or her *vikriti*.[72] The wider the gap between one's prakriti and one's vikriti, the more likely illness will be.

Ayurveda sees human health as a balance in the doshas, illness as an imbalance.[73] Too much pitta can lead to inflammation. Too much kapha can express itself as sinus congestion or edema. Like Western medicine, Ayurveda treats these conditions in an effort to restore full health. Unlike much Western medicine, though, Ayurveda focuses on maintaining health, not curing disease. This may be part of what makes Ayurveda

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71. Vasant Lad, "Ayurveda: A Brief Introduction and Guide," *The Ayurvedic Institute*, accessed March 17, 2020, https://www.ayurveda.com/pdf/intro_ayurveda.pdf.

72. Ayurvedic literature sometimes transliterates this word *vikriti*, sometimes *vikruti*.

73. Jaiswal and Williams, "A Glimpse of Ayurveda."

attractive to many Westerners. Why pay the cost of treatment, they wonder, if one can prevent many illnesses in the first place? Vaidyas may prescribe tulsi tea as an anti-diabetic.[74] Their counsel to the patient, though, will focus on changes to diet and activity. Keeping people healthy is more important to Ayurveda than prescribing medicine.

PHILOSOPHICAL & THEORETICAL FOUNDATIONS: OBJECTIONS

For some critics, Ayurveda's religious foundation disqualifies it as a science. The concern seems to be that its worldview is incompatible with modern thinking. To many modern thinkers, all things that exist are reducible to the natural and physical. A god that transcends nature cannot exist because the supernatural cannot exist.[75] Even if such a god did exist, that god could have no causative effect on the natural world. Ayurveda's mythic foundation and religious ties to Hinduism seem insuperable obstacles. One can excuse ancient vaidyas who attributed Ayurvedic healing to the gods. The problem is that many of today's practitioners do, too.

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74. Lesley Braun and Marc Cohen, *Herbs & Natural Supplements: An Evidence-Based Guide*, vol. 2 (Sydney: Churchill Livingstone, 2015), 997. "Tulsi has been found to have effective anti-diabetic activity in human trials."

75. This statement begs the question. Its premise assumes what its conclusion asserts.

This line of objection is an unfair disqualification. Many modern sciences were born in a mythic, pre-enlightened past. One should not dismiss them for how their embryonic versions understood the world. Who discounts astronomy, for example, because its intellectual ancestors were religious astrologers? Who disregards chemistry because its pioneers practiced alchemy? Hippocrates and Galen believed that four fluids control the body. Should one dismiss modern medicine on account of their humoral theory? Ancient physicians and natural philosophers accounted for the world as best they could.[76] They could explain reality only with the concepts and information available to them. This is no less true for ancient Ayurvedic physicians.

Other critics are concerned that Ayurvedic practitioners attribute natural phenomena to metaphysical entities. This concern sounds religious, but it is more philosophical or methodological. Before addressing the objection, it is necessary to qualify the term *Ayurvedic practitioner*. This paper addresses beliefs and practices of ancient healers and present-day vaidyas. Its discussions of history and philosophy are helpful and important for understanding Ayurveda. The thesis, though, defends Ayurveda's *modern* expression. The vaidyas being defended are modern practitioners with modern Western educations.

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76. Lawrence Principe, *Scientific Revolution* (Oxford: Oxford University Press, 2011). Principe traces the development of science from myth (pre-science) to protoscience to modern science.

This qualification does not detract from the critic's contention, however. Some practitioners today do indeed see metaphysical causes behind natural effects.[77] This objection is insufficient to disqualify Ayurveda as a genuine science, though. Stating the concern more precisely will help explain why. Some modern practitioners see metaphysical causes *behind the natural causes* of natural effects. They believe that there is a God or a nonphysical "energy" at work in the universe.[78] They believe that this metaphysical entity interacts with the physical world. Some believe that this entity interacts with the physical world in a sustaining way. Others believe that the entity interacted with the world only to bring it into existence.

Many of today's Ayurvedic practitioners hold such views. Still, *modern* vaidyas practice medicine within a natural effect–natural cause framework. In this way, some modern Ayurvedic physicians are like some Western scientists. Many a biomedical physician believes that God performs medical miracles. In one poll of 1,100 US physicians, nearly three out of four do.[79] One ought not to dismiss modern medicine because of these doctors' metaphysical beliefs. Regardless of those beliefs, they approach

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77. Vasant Lad may be an example.

78. Some view the metaphysical as plural: gods, for example, or "energies."

79. Shoba Sreenivasan and Linda E. Weinberger, "Do You Believe in Miracles?" *Psychology Today*, December 15, 2017, https://www.psychologytoday.com/us/blog/emotional-nourishment/201712/do-you-believe-in-miracles.

medicine as methodological naturalists.[80] The same can be said of the Ayurvedic practitioners this paper defends. Some twenty-first-century vaidyas believe that Vishnu enlightens their minds and guides their hands.[81] Some believe that Ganesha removes obstacles to good health.[82] Even so, these vaidyas research, diagnose, advise, and treat as if the gods did not exist.

Another line of objection to Ayurveda focuses on the pancamahabhutas, doshas, and prakriti. Some critics are concerned that they seem to have immaterial natures. Granted, modern scientists may believe God to be working *behind* natural causes. May a genuine scientist interpret an immaterial "substance" *as* a natural cause, though? If the pancamahabhutas are immaterial, how can they account for humans' physical existence? If the doshas are immaterial, how can they be biological mechanisms of action? If the prakriti is immaterial, how can it produce human beings? Ayurveda cannot be a genuine science if its core concepts have no physical existence.

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80. David Papineau, "Naturalism," *Stanford Encyclopedia of Philosophy*, September 15, 2015, https://plato.stanford.edu/entries/naturalism/.

81. Vishnu is "a god, originally a minor Vedic god, now regarded by his worshipers as the supreme deity and savior, by others as the preserver of the cosmos in a triad with Brahma and Shiva. Vishnu is considered by Hindus to have had nine earthly incarnations or avatars, including Rama, Krishna, and the historical Buddha; the tenth avatar will herald the end of the world" (*NOAD*).

82. Ganesh/-a is "an elephant-headed deity, son of Shiva and Parvati. Worshiped as the remover of obstacles and patron of learning, he is usually depicted colored red, with a potbelly and one broken tusk, riding a rat" (*NOAD*).

Other critics grant that the pancamahabhutas', doshas', and prakriti's natures are material. These critics challenge their identities. Ayurveda teaches that every natural thing is made of earth, water, fire, air, and space. How can a genuine science cling to these five "elements" as the building blocks of the world? These two objections to the pancamahabhutas, doshas, and prakriti are formidable. Clarifying how Ayurveda sees their natures and identities requires a careful response. That response needs to consider three different Ayurvedic mindsets: ancient, traditional, and modern.[83]

Ancient vaidyas are those of the premodern world. They recognized no separation between the metaphysical and the physical. Their worldview saw gods and mortals playing on the same cosmic stage. They saw their minds as receptacles of divine revelation and reflectors of its truth. Their scriptures were sources of knowledge and arbiters of experience. Ancient vaidyas were children of their time. Their Ayurveda cannot determine the scientific standing of today's Ayurveda. The same cannot be said for the beliefs and practices of traditional and modern vaidyas.

Traditional vaidyas are practitioners of the modern era who ignore modern Western education. Traditional vaidyas downplay or deny the insights of modern medical science. Their training derives from the tenets and practices of ancient Ayurveda. Most traditional vaidyas study under traditional gurus, who themselves learned from traditional gurus. Traditional vaidyas overlook or look askance at biomedical principles, diagnostics,

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83. Nishal Ramnunan. Personal interview. 8 Dec. 2018. Thanks to Ramnunan for outlining this delineation.

and therapeutics. They have little regard for methodological naturalism and modern clinical methods. A Western analog is the zoologist who denies and resists evolutionary theory. The resistance stems not so much from scientific considerations as from ante-scientific commitments. Those prior commitments may be philosophical, religious, societal, or even political.

Traditional vaidyas view the pancamahabhutas, doshas, and prakriti as the ancients did. Defending their Ayurvedic practice as a genuine science would prove an exceptional challenge. Traditional vaidyas are by no means rare in the global Ayurvedic community. Writing for the WHO in 2011, P. N. V. Kurup estimated their number at 300,000 worldwide.[84] Still, their non-modern views do not represent most Ayurvedic schools and hospitals today.[85]

The third Ayurvedic mindset the critic of Ayurveda must consider is the *modern*. Modern practitioners represent a minority, but a growing and influential one. Given their

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84. P. N. V. Kurup, "Ayurveda," in *Traditional Medicine in Asia*, ed. Ranjit Roy Chaudhury and Uton Muchtar (New Delhi: World Health Organization, 1990), 3.

85. "Courses in Ayurveda," *Ministry of AYUSH | Courses in Ayurveda*, accessed April 5, 2020, http://ayush.gov.in/courses-ayurveda. According to Nishal Ramnunan, however, India's current prime minister wishes to see this change. A defender of Hindu nationalism, Narendra Modi advocates Ayurveda's returning to its Vedic roots. His concern seems to have little to do with medicine, more to do with casting off Western thought.

roles in colleges and hospitals, they are poised to shape Ayurveda's future.[86] Modern Ayurvedic practitioners and teachers embrace modern Western education. They view Ayurveda as a complement, not an alternative, to biomedicine. Still, typical modern vaidyas receive premedical educations in anatomy, physiology, and pharmacology.[87] They learn the scientific method, and they learn to value it in the practice of medicine. Modern vaidyas recognize the importance of methodological naturalism and the modern worldview.

When they describe the doshas, for example, they characterize them in biological terms. Modern Ayurvedic literature characterizes vata, pitta, and kapha as confluences of bodily systems. Alex Hankey of the Institute of Ayurveda Integrative Medicine, Bangalore, provides an example:

> In an age where validity of concepts is judged by their *scientific* relevance, establishing the scientific validity of Tridosha is a program of significance. It requires translating concept and practical application into the idiom of modern biology and medicine. Four different complementary approaches have been proposed to do so: factor analysis of human physiology; systems analysis of organism function; correlation of Dosha and genomic variations - Ayugenomics; and correlation of Dosha and cellular function.[88]

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86. Bhushan Patwardhan, "Bridging Ayurveda with Evidence-Based Scientific Approaches in Medicine," *EPMA Journal* 5, no. 19 (2014), doi.org/10.1186/1878-5085-5-19.

87. Kurup, "Ayurveda," 14.

88. Alex Hankey, "Establishing the Scientific Validity of *Tridosha*: Part 1: *Doshas*, *Subdoshas* and *Dosha Prakritis*," *Ancient Science of Life* 29, no. 3 (2010): 6,

The doshas comprise complex interactions among biological, chemical, and mechanical systems. Physical things, such as food, medicine, exercise, and weather, impact the doshas.[89] The right medicine for the right person at the right time brings bodily balance and health. The wrong food or medicine can have the opposite effect. Modern vaidyas make these causal connections based on the doshas' physical nature.

Modern Ayurveda sees an individual's prakriti in a similar physical way. The prakriti is a person's unique combination of doshas. The prakriti is understood to have a biological basis because the doshas do. US-based researchers Yogini Jaiswal and Leonard Williams describe scientific studies of Ayurvedic principles. Their integration of Ayurvedic and biomedical terms is typical in modern Ayurvedic literature. (The topics of their discussion will be taken up in the next section.) Their uses of *prakriti* and *dosha* lack precision. The concepts' biological nature is apparent, though.

> Rotti et al, have published several studies correlating the concept of prakriti in Ayurveda to present-day science. A report indicating the correlation of dominant prakriti with the Body Mass Index (BMI) and place of birth in individuals was

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https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3336287/pdf/ASL-29-6.pdf. For further information on the "Ayugenomic" approach, see Bhushan Patwardhan and Gerard Bodeker, "Ayurvedic Genomics: Establishing a Genetic Basis for Mind–Body Typologies," *The Journal of Alternative and Complementary Medicine* 14, no. 5 (2008): 571–76, doi.org/10.1089/acm.2007.0515.

89. Kurup, "Ayurveda," 6.

> published.[90] Studies involving subjects of various prakriti types viz. Vata, Pitta and Kapha, were carried out to identify molecular differences that affect susceptibility and responses of individuals to various environmental or disease conditions. A classification method for human population, with respect to DNA methylation signatures is reported based upon traditional Ayurveda concept of prakriti.[91] In a study involving genome-wide SNP (single nucleotide polymorphism) in 262 male individuals from three different prakritis, it was found that PGM1 gene is associated with energy production. PGM1 was found to be more homogeneous in Pitta prakriti, than the Kapha and Vata prakriti.[92, 93]

The authors discuss doshic types alongside BMIs, molecular characteristics, and DNA methylation. They mention a correlation between pitta dosha and the homogeneity of the PGM1 gene. The article does not address the prakriti's or the doshas' natures per se. Still, the authors' language *assumes* that the doshas are complexes of biochemical systems. The doshas are neither metaphysical entities nor literal earth, water, and the rest. The authors' approach to Ayurveda frames ancient medical ideas within modern scientific understandings. Later sections on methods show how this approach affects clinical practice and research.

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90. Harish Rotti et al., "Determinants of *Prakriti*, the Human Constitution Types of Indian Traditional Medicine and Its Correlation with Contemporary Science," *Journal of Ayurveda and Integrative Medicine* 5 no. 3 (2014): 167–75, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4204287/pdf/JAIM-5-167.pdf.

91. Harish Rotti et al., "DNA Methylation Analysis of Phenotype Specific Stratified Indian Population," *Journal of Translational Medicine* 13 no. 151 (2015): 1–12, doi:10.1186/s12967-015-0506-0.

92. Periyasamy Govindaraj et al., "Genome-Wide Analysis Correlates *Ayurveda Prakriti*," *Nature News* 5, 5786 (2015): 1–12, doi:10.1038/srep15786.

93. Jaiswal and Williams, "A Glimpse of Ayurveda," 52.

Some Ayurvedic practitioners today hold metaphysical views like those of their ancestors. They understand prakriti, puruṣa, pancamahabhuta, and dosha much as Suśruta and Charaka did. Others have more modern perspectives. To assess Ayurveda fairly, one needs to consider the views of both sorts of practitioner. Various sections below will highlight important developments in Ayurvedic understanding. Some of these discussions use five-elemental language, but only because Ayurveda does. "Earth," "water," "fire," "air," and "space" appear in contemporary discussions of the pancamahabhutas. The classical elements are implicit in every mention of the doshas and the prakriti, as well.

What is *meant* in each instance depends upon the "Ayurvedist" using the terms.[94] The use of ancient terms by today's Ayurvedists represents a hermeneutical spectrum. Some speak of the five elements and their doshic combinations as literal earth, water, etc. An increasing number of Ayurvedists use the elemental terms more like metaphors. Talk of *air* does not mean "the invisible gaseous substance surrounding the earth."[95] Instead, *air* points to some biology-based principle or process associated with vata dosha. This literal-to-figurative hermeneutical divergence represents a key development in Ayurvedic

94. "Ayurvedist" is shorthand for Ayurvedic theorist, educator, practitioner, or researcher.

95. Stevenson and Lindeberg, ed., *NOAD*.

thought.[96] Its relevance to the question of Ayurveda's scientific standing may be apparent.

Of course, using language that points to a biological process is not the same as defining the process. To a modern Ayurvedist, pitta is not, of course, made of what consumes wood in a fireplace. Rather, it signifies a complex of biological, chemical, and physical mechanisms. This statement is vague and easy to make. It is more challenging to translate the concept of pitta into biomedical terms. Some Ayurvedists, such as Jayakrishna Nayak, have called special attention to the problem.[97] They want to see greater dialogue between Indian Ayurveda and Western biomedicine. For that to happen, these Ayurvedists realize, both sides must agree upon terminology.

The descriptions above characterize Ayurvedists delineated as *modern*. Without a couple of caveats, though, the response would be incomplete. The first concerns the confusing language used by some modern Ayurvedists. Ayurveda instructor Justin Robertshaw provides a clear example of the problem. He refers to the doshas as

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96. "Figurative" here means "representing a physical substance (or system) that is not literal earth, water, etc." "Figurative" does not mean metaphysical. Some Western Ayurvedists refer to the pancamahabhutas and doshas as "energies." This notion is a novelty in Ayurveda's history. It will be addressed below.

97. Jayakrishna Nayak, "Ayurveda Research: Ontological Challenges," *Journal of Ayurveda and Integrative Medicine* 3, no. 1 (January 2012): 17–20, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3326789/pdf/JAIM-3-17.pdf.

"energies."[98] By logical implication, then, the pancamahabhutas are energies. After all, the doshas are mere combinations of those five fundamental elements.

Some critics view an Ayurvedist's use of the term *energy* as a telltale sign of a medical pseudoscience. If doshic "energies" are real but nonphysical, however, then they must be metaphysical. If metaphysical, then they cannot be the basis of a genuine medical science. A conceptual framework that incorporates metaphysical entities betrays methodological naturalism. Other critics view such a use of the term *energy* as indicative of shoddy scientific thought. If Ayurveda says "energy" when it means a complex of biological systems, then it is doing bad science.[99] Alternatively, does "energy" refer to electricity, magnetism, or the like? If so, then Ayurveda posits a sort of scientific magic in its theoretical foundation. These concerns are understandable, but they prove less substantial than they first seem.

Calling the doshas "energies" need not indicate either bad science or pseudoscience. It may indicate, instead, a failure to find more precise, less misleading language. Indeed, Robertshaw elsewhere defines a doshic type as a person's "biological constitution."[100] Ayurveda conceives of the doshas (and underlying pancamahabhutas) as

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98. "Q&A with Ayurvedic Lifestyle Mentor, Justin Robertshaw," *Mala Love*, January 24, 2017, https://www.lovemalalove.com/questions-answer-with-justin/.

99. Of course, charging Ayurveda with doing *bad* science entails that it is doing *science*.

100. "Q&A with Ayurvedic Lifestyle Mentor."

material. It views them as comprised of, influencing, and being influenced by biological processes. The doshas are neither electromagnetic energies nor esoteric metaphysical entities.

Modern Ayurvedic literature explores the doshas' biological basis. It seeks to isolate the doshas' mechanism of action. Are the doshas rooted in people's genes? That is, do the doshic types represent six common genetic variations among humans? Are they rooted, more proximally, in six principal species-wide metabolic variants? Questions such as these will be taken up in the next section. What modern Ayurvedic literature makes clear about the doshas is this. Whatever they are in precise scientific terms, they are neither immaterial nor electromagnetic.

The second caveat about modern Ayurvedists concerns the "mystical outliers." Vasant Lad and Deepak Chopra are notable examples. These contemporary Ayurvedists incorporate into their views metaphysical, paranormal, or otherwise unscientific ideas. A scene from the documentary film *The Doctor from India* demonstrates the problem.[101] The film spotlights the work of Vasant Lad, a vaidya trained in Pune, India. In the late 1970s, he was one of the first to bring Ayurveda to the West. The illustrative scene's context is Lad's seeing of patients in his Pune clinic. To diagnose and treat, a vaidya must

101. *Doctor from India*, directed by Jeremy Frindel (New York: Kino Lorber, 2018), https://www.kanopy.com/product/doctor-india.

first determine a patient's prakriti and vikriti. One traditional means of doing this is by examining the patient's pulses (more on this in the next section).

In the scene, Lad examines a man who has come to him for treatment. By checking *the man's* pulses, Lad claims to know *his mother's* present health condition. In another scene, Lad talks about feeling nature's "vibrations" while sitting under a tree. Popular Ayurveda teacher and yoga guru David Frawley explains Lad's abilities.[102] No ordinary Ayurvedic physician, Vasant Lad is a physician, a yogi, and a psychic.[103] The film presents remote diagnosis and "vibrational" perception as normal for Lad. Such purported abilities are not claimed by the typical modern vaidya, however. Neither Lad nor Chopra is representative of the modern Ayurveda this paper defends.

METHODS: DIAGNOSIS & TREATMENT

When one evaluates the methods used by a field of practice or research, what is one aiming to assess? One is aiming to determine how the field views the epistemic warrant for its claims. On what grounds, that is, do its practitioners and researchers believe its claims to be sound? When one asks about Ayurveda's methods, one asks questions such as the following. Are its diagnostic and therapeutic methods recognizable

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102. David Frawley is one of Deepak Chopra's longtime teachers. Information about Frawley is available at https://www.vedanet.com.

103. David Frawley in *Doctor from India*.

as scientific? What is the role of empirical evidence? What is the role of logical reasoning? What is the role of critical review? We can explore Ayurveda's answers by considering two groups, practitioners and researchers.

A visit to an Ayurvedic practitioner (AP) is like a visit to many a modern physician.[104] The practitioner takes the patient's medical history. She notes the patient's age, sex, place of birth, current address, and illness history. She notes what medications the patient has taken and what surgeries he has undergone. She notes diseases and conditions common in the patient's family, too. The practitioner makes clinical observations, as well. She observes the patient's gait and demeanor. She attempts to discern his mental and emotional states. She examines hair, skin, teeth, eyes, tongue, urine, stool, pulse, and respiration.[105] She asks about diet, rest, voiding, sex, work, and exercise.

Then, she makes a diagnosis based on prakriti assessment and symptom presentation. What she prescribes as a treatment may vary by patient because no two

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104. Kurup, "Ayurveda," 7.

105. An AP takes note both of the cardiac pulse and of the doshic pulses. The question of the doshic pulses' clinical, or sensory, content is intriguing. What exactly is an AP assessing when checking doshic pulses? The question is intriguing, but it also lies outside the scope of this paper. Whatever is being evaluated, the vaidya assumes it to be biological in nature. The vaidya also uses the doshic pulses to help determine prakriti and vikriti. Also interesting is the high concurrence rate of prakriti determination by experienced vaidyas. For further information on this last point, see Harish Rotti et al., "Determinants of *Prakriti*."

patients are ever the same. Indeed, diagnosis and treatment may vary with the same patient on different occasions. According to Ayurveda, one's prakriti adapts to one's age, the time of day, and the season of the year.[106] Two hypothetical patients' symptoms lead the AP to diagnose arthritis of the knee. For the inactive, pitta-dominant patient, she might advise short walks in the cool of the day. The kapha-dominant patient, though, might receive a turmeric decoction as an anti-inflammatory.

Ayurveda does not assume that the same treatment will work for everyone. This stands in stark contrast to the standardized approach of much Western medicine. Ayurveda researcher Shailaja Chandra describes Ayurvedic diagnostics and therapeutics this way. "Each individual is believed to have a special and unique constitution and the choice of therapeutic treatment is individualistic and holistic. Diagnosis is done in a patient specific manner and treatment is custom-made."[107] Some people will respond well to a certain treatment. Others will be unaffected by it or may even be harmed. Vaidyas need to know what can cause human illness, but they need to know their patients, as well. Biomedical protocols tend to look for and treat disease. Ayurveda aims to treat persons.

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106. Warrier, *Ayurveda*, 23.

107. Shailaja Chandra, "Ayurvedic Research, Wellness and Consumer Rights," *Journal of Ayurveda and Integrative Medicine* 7 no. 1 (2016): 7, doi:10.1016/j.jaim.2016.05.002.

Remarkably, the Vedas and Samhitas describe many modern medical conditions, including arthritis.[108] Modern APs do not rely on ancient texts to justify their treatment protocols, though. They turn first to Ayurveda's history of clinical presentations and treatment results. They know that APs have used X to treat Y for centuries and with effective result. They understand this history to serve as a diagnostic–therapeutic baseline, though. What worked for many people a century ago may not work for many today. Diets, psychological stresses, and the environment change over the years. Those changes affect an individual's prakriti. They also affect the collective prakritis of a people.

To diagnose and treat, modern APs rely on observation, logic, and Ayurveda's history. They base diagnoses on sensory data and abductive logic. A patient presents with a handful of symptoms. The vaidya evaluates the patient's history, lifestyle, prakriti, and vikriti. The AP renders a diagnosis that makes best sense of the information available.

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108. Ayurveda has long treated inflammatory and arthritic conditions. For information about treatment history and current research, see the following. Kumar P. R. Krishna, "The Efficacy of Ayurvedic Treatment for Rheumatoid Arthritis: Cross-Sectional Experiential Profile of a Longitudinal Study," *International Journal of Ayurveda Research* 2, no. 1 (2011): 8–13, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3157120/. See also Ali Mobasheri, "Intersection of Inflammation and Herbal Medicine in the Treatment of Osteoarthritis," *Current Rheumatology Reports* 14 (2012): 604–16, doi:10.1007/s11926-012-0288-9. See too Subramani Parasuraman, Gan Siaw Thing, and Sokkalingam Arumugam Dhanaraj, "Polyherbal Formulation: Concept of Ayurveda," *Pharmacognosy Reviews* 8, no. 16 (2014): 73–80, doi:10.4103/0973-7847.134229. Helpful also is Ramar Perumal Samy, Peter Natesan Pushparaj, and Ponnampalam Gopalakrishnakone, "A Compilation of Bioactive Compounds from Ayurveda," *Bioinformation* 3, no. 3 (2008): 100–10, doi:10.6026/97320630003100.

Then, the AP determines a course of treatment based on (probabilistic) induction. The vaidya prescribes curatives that have a long, successful track record. If panchakarma has worked for so many with a similar prakriti in the past,[109] it is likely to work again today.

One Ayurvedic remedy that has received much recent attention is turmeric. Not only a cooking spice, the orange powder has played a prominent role in Ayurveda for centuries.[110] Vaidyas often prescribe turmeric-rich polyherbal decoctions to reduce inflammation.[111] Inflammation can be "a localized physical condition in which part of the body becomes reddened, swollen, hot, and often painful, especially as a reaction to injury or infection."[112] Inflammation can also cause chronic disease, such as rheumatoid arthritis

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109. L. A. Conboy, I. Edshteyn, and H. Garivaltis, "Ayurveda and Panchakarma: Measuring the Effects of a Holistic Health Intervention," *The Scientific World Journal* 9 (2009): 272–80, doi:10.1100/tsw.2009.35. "Panchakarma is one of the prominent Ayurvedic tools used to restore balance to the body," Conboy and team explain. "Through the use of herbalized oils, body treatments (including oil massage), steam therapy, herbal paste therapy, nasal therapy, vomiting therapies, enema therapy, and purgation therapies, Panchakarma is designed to allow the body to rid itself of wastes that have accumulated and lodged in the body, creating blockages in the intelligent flow of the various systems, including the circulatory, nervous, and digestive systems. Once this cleansing process is complete, the body can resume its natural functioning without interference" ("Ayurveda and Panchakarma," 274).

110. Samy, Pushparaj, and Gopalakrishnakone, "Bioactive Compounds."

111. Parasuraman, Thing, and Dhanaraj, "Polyherbal Formulation." Vaidyas sometimes prescribe a single-herbal remedy for a particular condition. Often, they prescribe a polyherbal formulation. "This key traditional therapeutic herbal strategy exploits the combining of several medicinal herbs to achieve extra therapeutic effectiveness," explain Parasuraman, Thing, and Dhanaraj.

112. Stevenson and Lindeberg, ed., *NOAD*.

or inflammatory bowel disease. One group of turmeric's key phytochemicals, the curcuminoids, have piqued biomedical interest.

Some laboratory research appears to support the Ayurvedic remedy's claim. Musculoskeletal researcher Ali Mobasheri and team provide an example of supporting evidence. He and his team were investigating herbal medicines as potential treatments for osteoarthritis. They conducted in-vitro research into curcumin's biological action. Mobasheri concluded that "results indicate that curcumin is a safe and promising herbal medicine for treatment of OA [osteoarthritis]. However, its efficacy and bioavailability must be studied in greater detail in-vivo."[113] Mobasheri recognizes the need for more research into curcumin's potential in humans. Still, he finds promise in the principal phytochemical of a key Ayurvedic remedy.

Another example of supporting laboratory evidence comes from a team of oral-medical researchers. Syeda A. Ara and his team reviewed studies of curcumin, turmeric's key curcuminoid. They were investigating its use for treating oral submucous fibrosis (OSMF). The researchers did not find the evidence they sought. "There is a lacunae [*sic*] for scientific review of curcumin for … OSMF," they write.[114] They did, however, find support for curcumin's anti-inflammatory usefulness. "By modulating the activation of

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113. Mobasheri, "Inflammation and Herbal Medicine," 608.

114. Syeda Arshiya Ara et al., "Research on Curcumin: A Meta-Analysis of Potentially Malignant Disorders," *Journal of Cancer Research and Therapeutics* 12, no. 1 (2016): 175–81, doi:10.4103/0973-1482.171370.

various transcription factors," the team explains, "curcumin regulates the expression of inflammatory enzymes."[115] Though recent and still scant, research is starting to show how turmeric's curcumin works.

Many practitioners in complementary and integrative medicine tout turmeric's curcumin as an anti-inflammatory. Many on the Internet tout it as an anti-bacterial, anti-fungal, and anti-viral, as well. More extreme voices claim that it cures cancer, Alzheimer's disease, and baldness. Some researchers find no evidence for any such curcumin claims. Medicinal chemist Kathryn M. Nelson and her team counter them in the strongest terms.

> The likely false activity of curcumin in vitro and in vivo has resulted in >120 clinical trials of curcuminoids against several diseases. No doubleblinded, placebo controlled clinical trial of curcumin has been successful. This manuscript reviews the essential medicinal chemistry of curcumin and provides evidence that curcumin is an unstable, reactive, nonbioavailable compound and, therefore, a highly improbable lead.[116]

Nelson and her team dismiss curcumin claims as nearly groundless. Curcumin is "a highly improbable lead."[117] If so, then Ayurveda's claims about turmeric's

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115. Ara et al., "Research on Curcumin."

116. Nelson et al., "The Essential Medicinal Chemistry of Curcumin," *Journal of Medicinal Chemistry* 60, no. 5 (2017): 1620, doi:10.1021/acs.jmedchem.6b00975.

117. Nelson et al., "Chemistry of Curcumin," 1620.

effectiveness would appear to be baseless. This may seem a clear implication, but Nelson's team stops short of drawing that conclusion. Researchers admit they "do not rule out the possibility that an extract of crude turmeric might have beneficial effects on human health."[118] The researchers' study describes the lack of supporting evidence for *curcumin* claims. It does not rule out the potential effectiveness of turmeric itself. Nelson and her team may have intended only to refute claims about turmeric's key curcuminoid.[119] To be clear, Ayurveda has had much success with *turmeric* as an anti-inflammatory. It has never attempted to isolate and prescribe the chemical constituent *curcumin*.

Turmeric is one plant-based Ayurvedic treatment among thousands. Laboratory research has begun investigating the biochemical basis of claims made for it. Research has begun to investigate claims for other Ayurvedic medicinals, also. PubMed searches for "ashwagandha," "tulsi," and "bacopa monnieri," for example, bear this out.[120] One early Western investigation involved the Ayurvedic herb *sarpagandha*, or Indian

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118. Nelson et al., "Chemistry of Curcumin," 1631.

119. Bhushan Patwardhan, "Ayurvedic Drugs in Case: Claims, Evidence, Regulations and Ethics," *Journal of Ayurveda and Integrative Medicine* 7, no. 3 (2016): 135–37, doi:10.1016/j.jaim.2016.08.005. Patwardhan has a similar concern about how Ayurvedic medicines are advertised in India. He criticizes the "blatant cheating through misleading commercial advertisements claiming cure for many incurable diseases (135)."

120. PubMed is a service of the U.S. National Library of Medicine's National Center for Biotechnology Information. It is available at https://pubmed.ncbi.nlm.nih.gov/.

snakeroot. Ayurveda has used the herb to treat fever and insanity. Western researchers isolated the herb's chemical mechanism of action. From the isolated chemical, the reverse-engineered pharmaceutical reserpine was produced. Reserpine is now used to treat hypertension and schizophrenia.[121] Conventional medicine has only recently started paying attention to Ayurveda's herbal medicines. This fact is not tantamount to there being no strong evidence for Ayurveda's claims. It is only a recognition of biomedicine's longstanding lack of interest.

Sometimes, critics deny the effectiveness of Ayurvedic remedies. Sometimes, they issue stern warnings about those remedies' potential harm. An example is the warning about the toxicity of certain Ayurvedic preparations. Most Ayurvedic medicines are herbal blends solely. Some, though, are prepared as *rasa shastra*. Rasa shastra preparations combine herbs with metals, minerals, or gems. Most often, the metals used

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121. Bhushan Patwardhan and Raghunath Anant Mashelkar, "Traditional Medicine-Inspired Approaches to Drug Discovery: Can Ayurveda Show the Way Forward?" *Drug Discovery Today* 14, no. 15-16 (2009): 804–11, doi:10.1016/j.drudis.2009.05.009. See also R. D. Lele, "Beyond Reverse Pharmacology: Mechanism-Based Screening of Ayurvedic Drugs," *Journal of Ayurveda and Integrative Medicine* 1, no. 4 (2010): 257–65, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3117317/. Reverse pharmacology is one new avenue of investigation that shows promise. Researchers have begun to study successful Ayurvedic medicines' mechanism of action. The hope is that this may lead to new drugs and treatment protocols. Turmeric has been mentioned as a classic Ayurvedic treatment for inflammation. Another is frankincense, the aromatic gum resin. One research team at the University of Tübingen (in 2011) found it as effective as cortisone, but safer. The researchers hypothesized that its mechanism of action owed to its *Boswellian* acids. See *The Secret World of Wellness: Ancient India*, directed by Peter Bardehle (Langbein & Skalnik Media, 2007), https://youtu.be/1QYhh5bmQcE.

are lead, mercury, and arsenic.[122] Some traditional vaidyas claim that rasa shastra enhances herbal medicinals' therapeutic effect.[123]

Western medicine disagrees. Notable are the concerns and conclusions of two studies, one in 2004 and one in 2008, led by Robert B. Saper. Both studies set out to "determine the prevalence and concentration of heavy metals in Ayurvedic HMPs [herbal medicine products]."[124] The 2004 study looked at HMPs sold in the Boston area; the 2008 study, at HMPs sold on the Internet. Both studies' conclusions were similar. "One-fifth of … Ayurvedic medicines purchased … contain detectable[125]/potentially harmful levels of[126] lead, mercury, or arsenic." In 2012, the CDC issued a related report about six cases of lead poisoning in New York City.[127] Six pregnant women had ingested toxic

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122. Technically, arsenic is a metalloid.

123. Parasuraman, Thing, and Dhanaraj, "Polyherbal Formulation."

124. Robert B. Saper et al., "Heavy Metal Content of Ayurvedic Herbal Medicine Products," *JAMA* 292, no. 23 (2004): 2868–73, doi:10.1001/jama.292.23.2868.

125. Robert B. Saper et al., "Lead, Mercury, and Arsenic in US- and Indian-Manufactured Ayurvedic Medicines Sold via the Internet," *JAMA* 300, no. 8 (2008): 915–23, doi:10.1001/jama.300.8.915.

126. Saper et al., "Heavy Metal Content."

127. "Lead Poisoning in Pregnant Women Who Used Ayurvedic Medications from India — New York City, 2011–2012," *Morbidity and Mortality Weekly Report* 61, no. 33 (August 24, 2012): 641–46, https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6133a1.htm.

levels of the metal in rasa shastra medicines. Such findings have caused many physicians and officials grave unease about Ayurvedic preparations.

Ayurveda's responses to concerns about heavy-metal toxicity appear to be mixed.[128] It appears that the responses tend to fall along the traditional–modern divide. Some modern Ayurvedists raise the same alarm as Western physicians and health officials. Others see the issue from a more traditional Ayurvedic perspective. Traditional Ayurvedists have concerns about some rasa shastra preparations, too. Their complaints are not about the use of metals in Ayurvedic medicinals per se. They point out that some medicines are designed to include metallic ingredients. Instead, they question why the metals remained toxic after the rasa shastra process. Some of these Ayurvedists attribute residual heavy-metal toxicity to improper production.[129] Others attribute it to environmental contamination of botanical (or other) ingredients.

Rasa shastra medicines should be safe and effective, traditional Ayurvedists maintain.[130] They must be prepared correctly and administered properly, though.[131] Rasa

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128. An interesting question is whether AYUSH—and, thus, the Indian government—approves the use of rasa shastra preparations.

129. Parasuraman, Thing, and Dhanaraj, "Polyherbal Formulation."

130. *Ayurveda: Art of Being*, *YouTube*, accessed March 18, 2020, https://youtu.be/VgJJlceH-vA. At the 34-min. and 55-min. marks, Brahmanand Swamigal explains the shodhana process and provides a demonstration.

131. Janmejaya Samal, "Can the Recent Public Notice by the Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy Be Helpful in

shastra preparations undergo a blending process called *shodhana*. This process involves blending, heating, cooling, and pulverizing. Shodhana, according to classical Ayurveda, purifies, potentiates, and detoxifies ingredients. Ancient vaidyas discovered curious chemistries when combining various botanicals with certain metals. According to classical texts and Ayurvedic custom, the metals activate the botanicals. The botanicals, in turn, buffer the metals, rendering them no longer harmful.

Traditional Ayurvedists are not clear about how rasa shastra preparations enhance therapeutic effect. In what way do metals augment beneficial phytochemical activity? Nor are traditional Ayurvedists clear about shodhana's mechanism of action. How exactly do chemicals in some plants detoxify chemicals in some metals? If some plants can detoxify some metals, why do the plants not render the metals altogether inert? A typical Western critic might counter that shodhana *cannot* detoxify heavy metals. The suggestion that it can is (pseudoscientific) alchemy by another name. The criticism is understandable.

Still, the traditional Ayurvedist's claims about shodhana have a prima facie plausibility. Neurologist Bala Manyam explains. "Ayurvedic drugs have been taken for thousands of years, mostly in India, and if the lead in [these medicines] was poisonous,

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Combating the Irrational Use of Herbal Drugs?" *Journal of Family Medicine and Primary Care* 5, no. 3 (2016): 732–33, doi:10.4103/2249-4863.197286.

we should have an epidemic of lead poisoning. But we never had anything like that."[132] Millions of Indians have taken rasa shastra medicines for millennia. If they are essentially poisonous, then India should have experienced a metal-toxicity epidemic. India has not; therefore, rasa shastra medicines are not essentially poisonous.

Manyam makes a valid modus-tollens argument, though it is sound only if its premises are true. His argument is sound, that is, only if no metal-toxicity epidemic has ever existed in India. Manyam's premise has prima facie plausibility. It is possible that India has suffered many an epidemic of heavy-metal poisoning. One wonders, though, where the evidence of such epidemics is. Surely, there should be plenty after millennia of rasa shastra use, but this does not appear to be the case. Critics may dismiss Manyam's view, but they will need to answer his implied question. Why do only a relative few develop heavy-metal poisoning from rasa shastra medicines? The answer may be that shodhana is not alchemy, but a chemistry not yet understood.

The clinical practice of today's APs is like that of Western physicians.[133] Vaidyas diagnose patients based on self-reports and presenting symptoms. They weigh their

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132. Bala Manyam, qtd. in Lallanilla, "Ayurveda."

133. Kishor Patwardhan et al., "The Ayurveda Education in India: How Well Are the Graduates Exposed to Basic Clinical Skills?" *Evidence-Based Complementary and Alternative Medicine* (2011): 1–6, doi:10.1093/ecam/nep113. According to Patwardhan et al., the AP described here is unlike some graduates of Ayurveda programs. They lack basic knowledge and skills, both in biomedicine and in Ayurveda. Their lack of preparation risks both Ayurveda's integrity and patients' health.

knowledge of how a patient's body *should* function against how it *is* functioning. They assess observed and reported empirical evidence and draw a diagnostic conclusion. They prescribe a remedy that has a well-demonstrated therapeutic effect. Unlike some Western physicians, though, APs advise patients on how not to be patients. They counsel them on lifestyle choices that will help balance their psycho-physical constitutions. The vaidya's aim, says Ayurveda, is not so much to treat disease as it is to heal persons.[134]

METHODS: RESEARCH & REVIEW

Randomized, double-blind, placebo-controlled studies (RCTs) are the gold standard in biomedicine.[135] RCTs test drugs, validate therapies, and provide parameters for future, more targeted testing. In a basic RCT format, a cohort of test subjects is sorted at random into two groups. Everyone in Group 1 receives the target treatment; everyone in Group 2, a placebo. Researchers do not know which group receives what, nor do test participants. A successful RCT is one that shows significant therapeutic benefit to those in Group 1. Those in the target group, that is, need to have benefitted more than those in

134. Ramnunan.

135. Eduardo Hariton and Joseph J. Locascio, "Randomised Controlled Trials - The Gold Standard for Effectiveness Research," *BJOG: An International Journal of Obstetrics & Gynaecology* 125, no. 13 (2018): 1716, doi:10.1111/1471-0528.15199.

the placebo group. RCTs standardize medical testing to reduce both experimental error and researcher/participant bias.

Randomized control trials present challenges for Ayurveda's holistic, prakriti-tailored treatment approach.[136] They are also contrary to a core Ayurvedic principle. Ayurveda tailors its treatment protocols to the *individual*'s psycho-physical constitution. Ayurvedic practitioners and academics alike see this as a system strength.[137] Rarely does any symptom, condition, or disease present in every person the same way. Rarely does any drug or surgery have identical effects on all who receive them. Ayurveda recognizes the *medical* significance of individuals' anatomical, physical, and psychological differences.

Western physicians do, too, but *biomedical testing methods* often belie that recognition. The RCT's methods are standardized, but its human test subjects are not. Even those who defend the RCT as biomedicine's gold standard admit this deficiency. Eduardo Hariton and Joseph J. Locascio are examples. In an article defending the RCT, they call attention to three of its "drawbacks."[138] They are costly and are often not

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136. *Holistic* is used in a technical sense. Holistic systems of medicine are "characterized by the treatment of the whole person, taking into account mental and social factors, rather than just the symptoms of a disease" (*NOAD*).

137. Chandra, "Ayurvedic Research."

138. Hariton and Locascio, "Randomised Controlled Trials."

followed up. RCTs also have "problems with generalisabilty."[139] The authors clarify this point, writing that those "that volunteer to participate might not be representative of the population being studied."[140] Test members may not be the sort of subject the trial intends to study. This is problematic, because an RCT purposes to study the effects of X on population Y.

The drawbacks Hariton and Locascio mention are not the RCT's only complications. Another is that researchers cannot count on the consistency of cohorts across RCTs. This is true even when the cohorts *are* representative of the studied population. An RCT's success depends upon predictable responses in a target population. Different cohorts for different RCT phases, though, may be more homogeneous or less so. Their basic demographics, medical histories, and treatment responsiveness will not be identical. This sort of variability introduces a confounding element not easily compensated for. RCTs may speak of "populations" and "cohorts," but all groups are made up of individual persons. What is true of a whole will not always be true of its parts.

Still, many Ayurvedists see value in substantiating Ayurvedic claims using modern methods. Many appreciate the rhetorical persuasiveness that biomedical validation would provide. If modern methods can show Ayurveda's effectiveness, then its

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139. Hariton and Locascio, "Randomised Controlled Trials."

140. Hariton and Locascio, "Randomised Controlled Trials."

influence will grow. Conventional medicine will begin to take its diagnostics, therapeutics, and research seriously. It will have a greater impact on global healthcare by supplementing conventional options. RCTs present an exceptional challenge for Ayurveda, though. They presuppose and require standardization; Ayurveda, individualization. This does not imply that RCTs are of no potential benefit to Ayurveda.

Nor does it imply that Ayurvedist researchers cannot devise a satisfactory alternative. Former Indian-national public health minister Shailaja Chandra has suggested two alternatives.[141] The first focuses on numerous careful case studies. Invite volunteer patients at allopathic hospitals to receive Ayurvedic treatment at government expense.[142] Patients would be sufferers of common conditions, such as arthritis, hypertension, and IBS. APs could treat them as they saw fit, and biomedical researchers could review results. They would assess relevant health parameters from before, during, and after treatment. Reviewers would use whatever diagnostic and laboratory tools needed to render an evaluation.

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141. Chandra, "Ayurvedic Research."

142. In India, conventional Western medicine is often referred to as "allopathic" medicine. The term derives from one of biomedicine's foundational principles. Treat illness with its cause's opposite (from Greek *allos*, "other"). Chandra recommends that these RCT alternatives be conducted at government expense. This recommendation owes to at least three considerations. One, the government has an interest in validating what is in its people's best medical interest. Two, research studies are expensive; government funding removes the financial burden. Three, patients are not likely to volunteer for a study at their own expense.

Chandra's second suggestion of RCT alternative focuses on reviews of clinical cases. She estimates that key Ayurvedic hospitals hold tens of thousands of patient records. Certain medical conditions presenting and treated could be targeted for retrospective analysis. Studies could target those treated for the amelioration of tuberculosis, for example. Relevant pre- and post-treatment data could be gathered and input into analytical software. The software could show which treatments appeared to provide significant improvement.[143] Treatment data would prove valuable for use in reverse pharmacology, as well. Chandra's suggestions of RCT alternatives may not satisfy all Western researchers. Still, they demonstrate the possibility of using modern methods to validate Ayurveda. As important, they show that objective validation need not violate core Ayurvedic principles.

Advocates are eager to test Ayurveda because they believe in its benefits. They want to share its insights with wider audiences, too, popular and medical-scientific. Distinguished Ayurvedist educator Ram Harsh Singh sees great promise in recent research efforts. "The demand for new scientific evidence for the efficacy, safety, and quality of [Ayurvedic] medications is gaining momentum. Such a demand has motivated a large number of investigators to launch ambitious research and development activities.

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143. "Significant improvement" does not imply "better than conventional approaches." This phrase means only that patients were medically better off (relative to the target condition) upon discharge.

This is definitely a welcome development."[144] Singh mentions efforts to validate Ayurvedic medicines. Ayurveda's remedies are not limited to its pharmacopeia, though. Substantiating Ayurveda's broader claims will need to include treatments such as panchakarma.

One important component of biomedical validation is critical review. Ayurvedic research needs expert scrutiny from those within the system and outside it. Practitioners need to share their studies with other trained APs. They need to dialogue with conventional physicians and biochemical scientists, as well. One common (some say crucial) means of critical examination is the peer-reviewed journal. Rigorous, reputable journals allow researchers and practitioners to share their hypotheses and findings. They also invite the careful analysis, and disagreement, of other experts. Many Ayurvedists have only begun to see the value of such constructive-critical communities.

When Ayurvedists do publish robust articles, they tend to appear in Ayurvedic journals.[145] These articles rarely enter into conversation with those outside the Ayurvedic community. Ayurveda educator Kishor Patwardhan and his team value the rigors of peer-reviewed journals. They also observe that Ayurvedic journals have not yet reached their academic-scientific potential. This is due in part to a deficit in Ayurvedic education.

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144. Ramharsh Singh, "Exploring Larger Evidence-Base for Contemporary Ayurveda," *International Journal of Ayurveda Research* 1, no. 2 (2010): 65, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2924985/.

145. Within India, this means that they tend to appear in AYUSH-related journals.

Future APs need training in anatomy and physiology, diagnostics and therapeutics. They also need "frequent training programs on research methodology and scientific writing skills."[146] To be successful in a peer-reviewed community, researchers' methods must be sound. Their writing must be skillful. Until these are the norm in Ayurveda, its critical review will not be as fruitful or respected as it desires.

Some seek to disqualify modern Ayurveda as a science on methodological grounds. It is difficult to see the strength of that case, though. Modern Ayurvedic methods display the characteristics of many a scientific community. It bases its diagnostics and therapeutics on empirical evidence and sound reasoning.[147] It uses logical tools common to modern sciences: induction, abduction, and hypothetico-deduction. It values the testing of hypotheses and the validating of results by modern means.

Granted, Ayurveda does not fit well within the testing confines of biomedicine's RCTs. Its peer review is largely internal, too. It lacks the rigorous scrutiny of medical-scientific outsiders. These concerns are valid, but they do not warrant the dismissal of Ayurveda as a genuine science. Ayurveda's deficits in biomedical validation and review do not stem from resistance. They stem from an old-world science attempting to align itself with the modern world. Ayurveda considers itself a genuine science and a

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146. Kishor Patwardhan et al., "Peer Reviewed Journals of Ayurveda - An Appraisal," *Journal of Research and Education in Indian Medicine* 20, no. 3-4 (2014): 148, doi:10.5455/jreim.82-1434000477.

147. Singh, "Exploring Larger Evidence-Base," 66.

biomedical complement. As a community, it looks for ways to demonstrate the rationale for its beliefs. Modern Ayurveda invites the efforts of both the verificationist and the falsificationist. Their attempts to disprove Ayurveda show the Ayurvedic community what needs scientific reinforcement. These behaviors would be unusual for a pseudoscience.

RESEARCH CAVEATS & CONCESSIONS

Researching Ayurveda for this paper was like tiptoeing around the ocean. Then falling in. The topic is vast, stretching beyond where newcomers' eyes can see. Ayurveda's contours cover history, religion, philosophy, language, society, economics, and … medicine. Each one of these areas is in turn its own deep sea. Beneath the surface of Ayurvedic philosophy bubble ancient Hindu schools of thought. Beneath the simplicity of Ayurvedic terms swirl millennia of Sanskrit scholarship. Beneath the clear waters of anti-inflammatories churn the opacities of Ayurgenomics. Ayurveda is a worthy topic for a beachcomber's research. The researcher should be warned, however, that its depths are deceiving from the shore.

Deceiving views of one's topic are not uncommon in research. Deceiving views are unintentional, but they are no less distorted. Often, these distorted views owe to various cognitive biases. Cognitive biases are unintentional, usually unexpected malfunctions in our thinking. FUTON—"full text on the Net"— is one. Unfunded

researchers do not wish to pay to read *this* journal article when *that* one is free. Another common distortion is the "not invented here" bias. This clouded view of research affects the *sources* a researcher uses. A source may have an aversion to an idea merely because it came from a different community. A third common distortion is the confirmation bias. Research aims to be as objective as possible. Sometimes, though, researchers read research in the way they *want* it to be read. Cognitive biases are avoidable, but rarely entirely so. Doubtless, I have fallen prey at times to all three, so I ask the reader's understanding. The distortions were unintentional.

The decision to omit a discussion of the placebo effect was not. Some critics maintain that Ayurveda is an ineffectual medical pseudoscience. It does no one any good. Other critics recognize that Ayurveda has worked for millions of people. These critics do not attribute its success to science, however. They attribute any therapeutic benefit from Ayurveda to the placebo effect. The turmeric worked, they would insist, because the patient believed it would. Western medicine has long disparaged the placebo effect, which is puzzling. If biomedicine's aim is to heal patients, then it should applaud and marvel at it.[148] What is not to like about an inert X that brings people relief from their suffering? An interesting topic, the placebo effect is tangential to this paper's

148. Dominik Wujastyk, "Medical Error and Medical Truth: The Placebo Effect and Room for Choice in Ayurveda," *Health, Culture and Society* 1, no. 1 (2011): 221–31, doi:10.5195/hcs.2011.14. Wujastyk points out the therapeutic—and, thus, medical—value of the placebo effect. "The fact is, patients get well for many reasons, only some of them connected with the therapies administered by doctors" (224).

investigation. The question being considered is not whether Ayurveda works for people and if so, how. The question is whether Ayurveda is a genuine science.

The evaluation that follows this section will provide an answer to that question. The answer can be only provisional, though. This paper's exploration of Ayurveda has been a mere introduction. That is, the conclusion this paper reaches reflects the limited scope of its research. Important questions for future exploration include at least these two. First, what *are* the doshas? What is their biological basis? What accounts for some studies' abilities to predict doshic types? Second, what protocol can be developed to validate APs' diagnostics and therapeutics? If a given therapeutic success does not owe to the placebo effect, what accounts for it? What is the successful treatment's mechanism of action? Ayurveda is an ocean. Exploring its breadth and depth will take teams of researchers *years*. This researcher hopes only to have made a partial map of its seas.

CONCLUSION

This paper has sought to defend the claim that Ayurveda is neither superstition nor sham. More than a traditional system of medicine, it is a genuine medical science. Some critics will remain unconvinced. They will argue that a strong enough case has not been made. The claim has not been scientifically proven with irrefutable empirical evidence. These critics, though, may need a reminder of where the discussion began.

Distinguishing science from pseudoscience is an elusive endeavor. The effort has taxed some of the best minds in philosophy and science. Various thinkers have offered solutions that other thinkers have rejected. One of the rejected solutions is the critic's verificationism.

Martin Mahner provides the demarcation disagreement a reasonable compromise. He has suggested that science be thought of as a cluster concept of connected attributes. The more of them a given claim, field, or community possesses, the more likely it is to be scientific. The attributes he suggests can be inferred from his list of foundational questions. Most of Mahner's questions target epistemic warrant and empirical methods. It seems unlikely that philosophers or scientists would object to any of them. It seems as unlikely that any would object to his questions' implied answers. His questions are repeated here for convenience.

> Do they form a research community, or are they just a loose collection of individuals doing their own thing? Is there an extensive mutual exchange of information, or is there just an authority figure passing on his doctrines to his followers? Is the given group of people free to research and publish whatever they want, or are they censored by the reigning ideology of the society they live in . . . ? Does the domain of study consist of concrete objects, or does it contain fuzzy "energies" or "vibrations," if not ghosts or other spiritual entities? What are the philosophical background assumptions of the given field? Does its ontology presuppose a natural, causal, and lawful world only, or does it also admit supernatural entities or events? . . . Does it accept the canons of valid and rational reasoning? Do the principles of noncircularity and noncontradiction matter? Does it admit fallibilism or endorse dogmatism? Occam's razor or unfettered speculation? How important are testability and criticism? How important is evidential support? Can the reliability of its methods or techniques be

> independently tested? Do the theories have genuine explanatory or predictive power, or both? Are the theories fruitful? Are the data reproducible? Are there mechanisms of error elimination? Are its claims compatible with well-established knowledge, in particular law statements? Does the field borrow knowledge and methods from adjacent fields? Does it in turn inform and enrich neighboring fields, or is it isolated? Do the problems tackled in the field spring naturally from research or theory construction, or are the problems pulled out of a hat? Is the corpus of knowledge of the given field up to date and well confirmed, or is it obsolete, if not anachronistic? Is it growing or stagnating?[149]

The questions are repeated here for the critics' review and reflection, as well. Mahner pointed each one toward the answer most genuine sciences would provide. He also pointed them, unintentionally, toward how modern Ayurveda aims to answer them. Modern Ayurvedists value and require empirical evidence in support of medical claims. They embrace and employ the hypothesis testing of the scientific method. They understand the need to validate medical claims through experimentation and critical review. They seek to benefit and be benefited by rigorous interaction with conventional biomedicine. Their use of reason's different modes of logic mirrors Western approaches. Modern Ayurveda provides the "right" answer for most of Mahner's questions. A couple will take more time, though. As Ayurveda matures, it needs to grow in the areas of peer review and experimental validation. This growth will come as Ayurveda and biomedicine deepen their dialogue.

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149. Mahner, "Science and Pseudoscience," 752–77 (Kindle edition).

The cluster-concept approach to describing *science* cannot provide demarcation certainty. It cannot define what always and everywhere constitutes a genuine science. It can, though, provide an indication of whether a given field is likely to be a member of science's family. The curious might ask how many family characteristics a genuine science needs. This is a good question, but a debatable one. Its details are best left to philosophers and historians of science. For present purposes, it is safe to say that a genuine science should possess most of the family's features.

Current literature shows that modern Ayurveda meets that criterion. Ayurveda's modern expression shows a reasonable number of family-resemblance characteristics. This researcher finds that its chief deficits lie only in the two areas mentioned above. These areas, modern Ayurvedists see both as needs and as opportunities for growth. Ayurveda may not possess all the same modern scientific characteristics as biomedicine. It does not answer all of Mahner's questions in exactly the same way as conventional medicine. Still, Ayurveda answers enough of them the "right" way. The platypus does not give birth to live young; still, it is a mammal.

Born in the mists of antiquity, Ayurveda is an ancient healing art. Long before Hippocrates said, "First, do no harm," it was promoting health and happiness. More than a medical tradition, though, Ayurveda is a genuine medical science. It is a viable, and justifiable, complement to modern Western medicine. It is coming of age in the modern world. Ayurveda values the well-being of individuals, not merely the treating of their diseases. It seeks to keep them healthy, to keep their psycho-physical constitutions in

balance. To millions around the world, Ayurveda is a respected system of medical practice. It has become part of their and their families' health and wellness. To an increasing number, even in the modern West, Ayurveda is becoming a science of life.

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