What Is Pseudoscience?

Pseudoscience can be clearly distinguished from science only if a number of features are checked

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MOST PHILOSOPHERS have attempted to characterize science, and correspondingly pseudoscience, by a single feature. Some have chosen consensus as the mark of science, others empirical content, or success, or refutability, or the use of the scientific method, or what have you. Every one of these simplistic attempts has failed. Science is far too complex an object to be characterizable by a single trait—and the same holds for pseudoscience. Just as we must check a number of properties in addition to color and brilliance in order to make sure that a chunk of metal is not fake gold, so we must examine a number of features of a field of knowledge to ascertain whether it is scientific.

We shall characterize a science, as well as a pseudoscience, as a cognitive field, genuine or fake. A *cognitive field* may be characterized as a sector of human activity aiming at gaining, diffusing, or utilizing knowledge of some kind, whether this knowledge be true or false. There are hundreds of cognitive fields in contemporary culture: logic and theology, mathematics and numerology, astronomy and astrology, chemistry and alchemy, psychology and parapsychology, social science and humanistic sociology, and so on.

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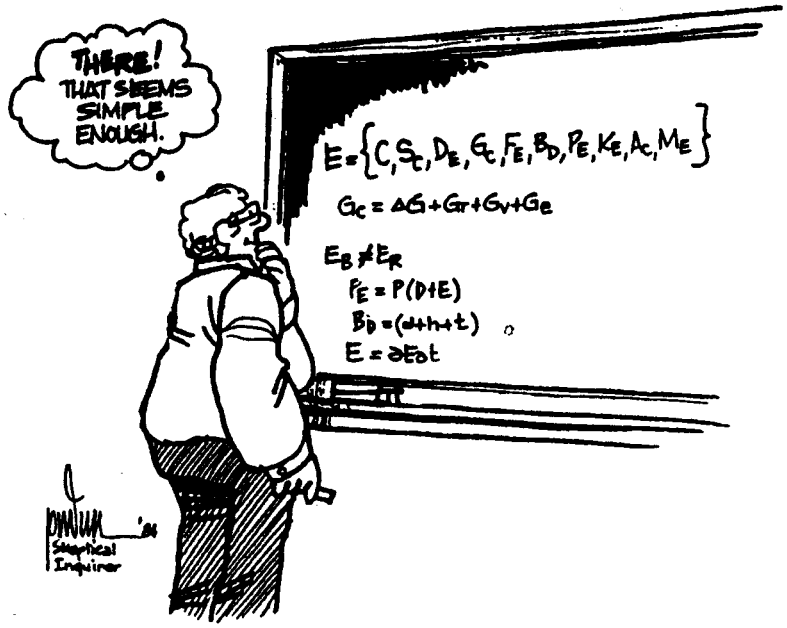


Cognitive Fields

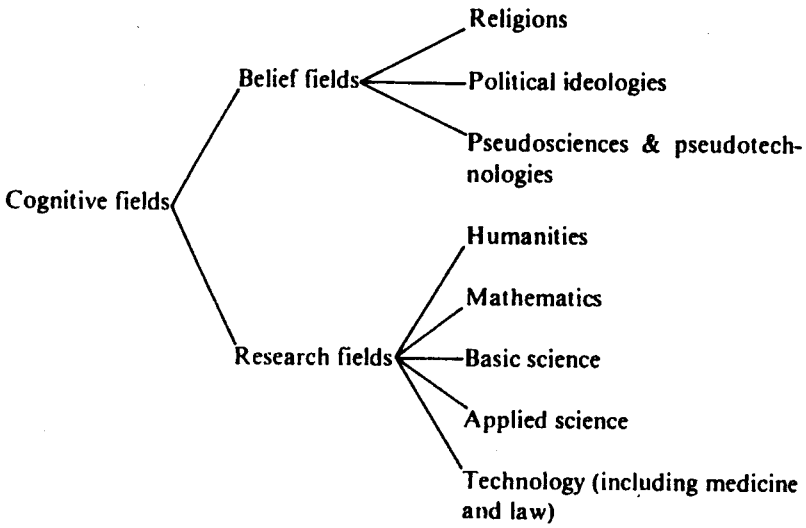
Whether or not a given cognitive field is successful in attaining truth or power, understanding or popularity, it shares a number of characteristics with other cognitive fields. (See Bunge 1983a.) These characteristics are encapsulated in the ten-tuple

$$E = (C, S, D, G, F, B, P, K, A, M),$$

where, at any given time,

- C = *Cognitive community*
- S = *Society hosting* C
- G = *General outlook,* or world-view, or philosophy of the C's
- D = *Domain* or universe of discourse of E: the objects E is about
- F = *Formal background:* logical and mathematical tools employable in E
- B = *Specific background,* or set of presuppositions about D borrowed from fields of knowledge other than E
- P = *Problematics,* or set of problems E may handle
- K = *Specific fund of knowledge* accumulated by E
- A = *Aims* or goals of the C's in cultivating E
- M = *Methodics* or collection of methods utilizable in E

The family of fields of knowledge is not homogenous. In fact it may be split into two disjoint sets: the family of *research fields* and that of *belief fields*. Whereas a research field changes all the time as a result of research, a belief field changes, if at all, as a result of controversy, brute force, or revelation. This, then, is the great divide:



Science

We now proceed to define the concept of science. (For details see Bunge 1983b.) We stipulate that a particular science, such as physics, biology, or sociology, is a cognitive field $E = (C, S, D, G, F, B, P, K, A, M)$ such that:

1. Every one of the ten components of E *changes*, however slowly, as a result of inquiry in the same field as well as in related fields (particularly those supplying the formal background F and the specified background B and E).

2. C, the research community of E, is a system composed of persons who have received a specialized training, hold strong information links among themselves, and initiate or continue a tradition of inquiry.

3. The society S, which hosts C, encourages or at least tolerates the activities of the components of C.

4. The domain D is composed exclusively of (certified or putatively) *real entities* (rather than, say, freely floating ideas) past, present, or future.

5. The *general outlook* or *philosophical background* consists of (*a*) an ontology according to which the real world is composed of *lawfully changing concrete things* (rather than, say, of unchanging, or lawless, or ghostly things); (*b*) a *realistic theory of knowledge* (rather than, say, an idealistic or a conventionalist one); (*c*) a *value system* enshrining clarity, exactness, depth, consistency, and truth; (*d*) *the ethos of the free search for truth* (rather than, say, that of the bound quest for utility or for consensus or for conformity with dogma).

6. The formal background F is a collection of *up-to-date logical or mathematical theories* (rather than being empty or formed by obsolete formal theories).

7. The specific background B is a collection of *up-to-date and reasonably well confirmed* (yet not incorrigible) *data, hypotheses, and theories* obtained in other fields of inquiry relevant to E.

8. The problematics P consists exclusively of cognitive problems concerning the nature (in particular the laws) of the members of D, as well as problems concerning other components of E.

9. The fund of knowledge K is a collection of *up-to-date and testable* (though not final) theories, hypotheses, and data compatible with those of B and obtained in E at previous times.

10. The aims A include discovering or using the laws of the D's, systematizing (into theories) hypotheses about D's, and refining methods in M.

11. The methodics M contains exclusively scrutable (checkable, analyzable, criticizable) and justifiable (explainable) procedures.

12. E is a component of a wider cognitive field, i.e., there is at least one other (contiguous) research field such that (*a*) the general outlooks, formal backgrounds, specific backgrounds, funds of knowledge, aims, and methodics of the two fields have nonempty overlaps, and (*b*) either the domain of one field is included in that of the other, or each member of the domain of one of them is a component of a system belonging to the other domain.

Any cognitive field that fails to satisfy all twelve of the conditions above will be said to be *nonscientific*. Classical examples: theology and literary criticism. And any cognitive field that, though nonscientific, is advertised as scientific will be said to be *pseudoscientific*. The reader is encouraged to check for himself whether his or her favorite science or pseudoscience satisfies the definition above.

Pseudoscience

In case our definition of pseudoscience is found as unsatisfactory as defining "fake art" as "not genuine art," let us propose an alternative characterization in positive terms. We propose to call a field of knowledge $E = (C, S, D, G, F, B, P, K, A, M)$ a *pseudoscience* if it satisfies jointly all the following conditions:

1. The ten components of E change but *little* in the course of time and, if they do happen to change, they do so in limited respects and as a

result of controversy or external pressures rather than of scientific research.

2. C is a community of *believers* who call themselves scientists, although they do not conduct any scientific research or they engage in research practices that are defective by scientific standards.

3. The host society S supports C for practical reasons (e.g., because E is good business) or tolerates C while relegating it beyond the border of its official culture.

4. The domain D teems with *unreal* or at least not certifiably real entities, such as astral influences, disembodied thoughts, superegos, and the like.

5. The general outlook G includes either (*a*) an ontology countenancing immaterial entities or processes, such as disembodied spirits, or (*b*) an epistemology making room for arguments from authority or for paranormal modes of cognition accessible only to the initiates or to those trained to interpret certain canonical texts, or (*c*) a value system that does not enshrine clarity, exactness, depth, consistency, or truth, or (*d*) an ethos that, far from facilitating the free search for truth, recommends the staunch defense of dogma, including deception if need be.

6. The formal background F is usually modest. Logic is not always respected and mathematical modeling is the exception rather than the rule. The few mathematical models that have been proposed (e.g., for psi phenomena) are not experimentally testable, so they are phony.

7. The specific background B is small or nil: a pseudoscience learns little or nothing from other cognitive fields. Likewise it contributes little or nothing to the development of other cognitive fields.

8. The problematics P includes many more practical problems concerning human life (in particular how to feel better and influence other people) than cognitive problems.

9. The fund of knowledge K is practically stagnant and contains numerous untestable or even false hypotheses in conflict with well-confirmed scientific hypotheses. And it contains no universal and well-confirmed hypotheses.

10. The aims A of the members of C are often practical rather than cognitive, in consonance with its problematics P. And they do not include the typical goals of scientific research, namely, the finding of laws or their use to understand and predict facts.

11. The methodics M contains procedures that are neither checkable by alternative (in particular scientific) procedures nor justifiable by well-confirmed theories. In particular, criticism is not welcomed by pseudoscientists.

12. There is no field of knowledge, except possibly another pseudoscience, that overlaps with E and is thus in a position to control or enrich E. That is, every pseudoscience is practically isolated: There is no such thing as the system of pseudosciences paralleling that of the genuine sciences.

This general picture is supplemented by Table I, which exhibits typical attitudes and activities of scientists and pseudoscientists. (Admittedly some scientists do not behave scientifically on occasion. But this is beside the point; we are concerned with norms or ideal behavior.)

TABLE I
Comparison of Attitudes and Activities of Scientists and Pseudoscientists

	Scientist			Pseudoscientist		
Typical Attitudes and Activities	Yes	No	Optional	Yes	No	Optional
Admits own ignorance, hence need for more research	x				x	
Finds own field difficult and full of holes	x				x	
Advances by posing and solving new problems	x				x	
Welcomes new hypotheses and methods	x				x	
Proposes and tries out new hypotheses	x					x
Attempts to find or apply laws	x				x	
Cherishes the unity of science	x				x	
Relies on logic	x					x
Uses mathematics	x					x
Gathers or uses data, particularly quantitative ones	x					x
Looks for counterexamples	x				x	
Invents or applies objective checking procedures	x				x	
Settles disputes by experiment or computation	x				x	
Falls back consistently on authority		x		x		
Suppresses or distorts unfavorable data		x		x		
Updates own information	x				x	
Seeks critical comments from others	x				x	
Writes papers that can be understood by anyone		x		x		
Is likely to achieve instant celebrity		x		x		

Parapsychology: Science or Pseudoscience?

Pseudoscience is a body of beliefs and practices but seldom a field of active inquiry; it is tradition-bound and dogmatic rather than forward-looking and exploratory. (In this respect it resembles ideology and, in

particular, religion.) For example, I have never heard of psychoanalytic, chiropractic, or homeopathic laboratories; only parapsychology, which deals with so-called spiritualistic, psychic, or extrasensory phenomena, is research-oriented. However, it fails to meet all the conditions listed previously for a cognitive field to be scientific. Let us check them, leaving the details to specialists such as Hansel (1980), Alcock (1981), and Randi (1982).

1. *Domain.* Parapsychology is avowedly about immaterial entities, such as disembodied spirits, the existence of which has never been established. So, it is a discipline without a subject matter. On the other hand, parapsychology (just as psychoanalysis and mentalistic psychology) ignores the very organ of the mind, namely, the brain.

2. *General outlook.* The philosopher C. D. Broad (1949) examined carefully the compatibility of parapsychology with the scientific worldview, which he called a "set of limiting principles," and concluded that parapsychology does not comply with them—whence they, not parapsychology, were given up by parapsychologists. For example, precognition violates the principle of antecedence ("causality"), according to which the effect does not happen before the cause. Psychokinesis violates the principle of conservation of energy as well as the postulate that mind cannot act directly on matter. (If it did, no experimenter could trust his own readings of his instruments.) Telepathy and precognition are incompatible with the epistemological principle according to which the gaining of factual knowledge requires sense perception at some point.

3. *Formal background.* The typical parapsychologist does not excel at handling formal tools, in particular, statistics. (See, e.g., Diaconis 1978.) Thus he consistently selects the evidence ("optional stopping" of a sequence of trials); he does not distinguish a coincidence (accidental or spurious correlation) from a causal relation or a genuine correlation; and he is not fond of mathematical models or even of informal hypothetico-deductive systems; his few hunches are stray.

4. *Specific background.* Parapsychologists make no use of knowledge gained in other fields, such as physics and physiological psychology. Moreover, they usually claim that the sciences are wrong or that they do not cover psychic phenomena. Worse, the (few and ancient) hypotheses of parapsychology are inconsistent with some of the basic assumptions of science. In particular, the very idea of a disembodied mental entity is incompatible with physiological psychology (see Bunge 1980). Worse, parapsychologists brush such inconsistencies aside.

5. *Problematics.* Parapsychology is extremely poor in problems: they all boil down to that of establishing at all costs that there are paranormal phenomena, i.e., facts that cannot be explained by normal science. Nor is this problem formulated in clear terms, and this because of the appalling theoretical indigence of parapsychology.

6. *Fund of knowledge.* Despite being several thousand years old and having attracted a large number of researchers over the past hundred years, we owe no single firm finding to parapsychology: no hard data on telepathy, clairvoyance, precognition, or psychokinesis, and no verisimilar hypotheses to explain the mechanisms of such alleged phenomena. All parapsychologists tell us is that their alleged data are anomalous, i.e., unexplained by the science of the day. Compare this behavior with that of a scientist, say an astronomer. If he were to find that a certain celestial object does not seem to "obey" the laws of celestial mechanics or of astrophysics, he would feel it his duty to offer or invite some positive conjectures—e.g., that it is not an ordinary body but a quasar or a black hole, a plasma or a laser beam, or some other physical thing. He may conjecture that this thing of a new kind "obeys" laws not yet discovered—but not that it violates well-established physical principles such as the conservation of energy. The parapsychologist does no such thing; he accepts apparently anomalous phenomena as evidence for paranormal abilities and takes no steps to explain them in terms of laws. Has anyone heard of the First Law of Clairvoyance, or the Second Law of Telepathy, or the Third Law of Psychokinesis? And has anyone ever constructed a perpetual motion engine driven by the mind, or a mathematical theory of spooks capable of making definite testable predictions?

7. *Aims.* Judging by the achievements of parapsychologists, their aim is not that of finding laws and systematizing them into theories in order to understand and forecast. Rather, their ultimate aim is either to buttress ancient myths or to serve as a surrogate for declining religions.

8. *Methodics.* The methods employed by parapsychologists have been scrutinized by scientists, statisticians, and stage magicians for more than a century and found almost invariably faulty. The most common defect is lack of strict controls. But deception—either unconscious, as in the case of the ordinary experimental subject who wishes the experimenter to succeed, or deliberate, as in the famous case of the spoon-benders—has always plagued parapsychology. (For plenty of amusing examples, peruse the back numbers of this journal.)

9. *Systemicity.* Far from being a component of the system of human knowledge, parapsychology is a stray; it makes no contact with other research fields. Therefore, its practitioners ask that it be judged on its own merits: on the strength of the empirical evidence they claim to have produced. But this is impossible, quite aside from the fact that such "evidence" is quite suspicious for having been produced with faulty methods—not to speak of old folk stories and other anecdotal "evidence" still going strong among parapsychologists. Indeed, any fact can be "read" or "interpreted" in a number of ways—i.e., explained by alternative hypotheses. This is reason that only hypotheses harmonizing with several other hypotheses are worth being investigated. This is not the case with the parapsychological

hunches; they do not form a (hypothetico-deductive) system, and they do not agree with science. (Recall point 4 above.) Moreover, parapsychologists themselves are proud of investigating phenomena, or rather pseudophenomena, that they regard as paranormal for lying beyond the reach of "official" (i.e., ordinary) science.

10. *Changeability*. Parapsychology cannot be said to be moving fast—let alone forward—the way every genuine science does these days. In fact, it is a collection of archaic beliefs that go back to primitive animism. Parapsychologists keep retesting the same conjectures over and over again without ever obtaining any conclusive results.

We conclude that parapsychology passes muster as a pseudoscience. If it is not always recognized as such it may be because a simplistic conception of science is presupposed. (A case in point is Marcello Truzzi's claim [1980] that, for a field to be scientific, it suffices that its practitioners employ the scientific method.)

Protoscience and Unorthodoxy

There is always the fear that some gold nuggets may lie hidden in a pile of pseudoscientific rubbish, that the latter may be nothing but protoscience, or emerging science. Such fear is quite justified in the beginning, particularly since an extremely original theory or technique—an unorthodoxy—may smack of pseudoscience just because of its novelty. But skepticism must succeed caution, and skepticism must in turn be replaced with denunciation if the novelty fails to evolve into a full-fledged component of science at the end of, say, half a century. Indeed, whereas the protosciences advance and end up by becoming sciences, the pseudosciences are stagnant pools on the side of the swift current of scientific research.

That "there may be something" in the odd claim of some pseudoscience is true but another matter. Thus the alchemists were right in holding that lead can be transmuted into gold. But they were wrong in believing that they would eventually bring about such transmutation, for (*a*) they lacked the necessary theory (of nuclear structure), (*b*) they lacked the necessary tool (particle accelerator), and (*c*) they lacked the possibility of acquiring either theory or tool, because they were hooked to tradition (in particular the four elements theory) and put their faith in dogma, in trial and error (rather than in well-designed experiment), and in magical incantation. So the modern discovery of (genuine) transmutation was just a coincidence—the more so since the alchemists rejected atomism.

Likewise telepathy may be a fact after all—though not clairvoyance, precognition, or psychokinesis, all of which conflict with basic physical laws. However, if the thought transmission does exist, then it must be a physical process. So, if it were discovered, it would not confirm parapsychology, but would become a subject of ordinary scientific research, like the transmutation of lead into gold. Such discovery would be the *coup de grâce* of parapsychology, just as the chemistry of Boyle finished off alchemy and Newtonian astronomy killed astrology.

Scientific unorthodoxy is a different kettle of fish altogether; it is just unconventional or unpopular science. Field physics was unorthodox when it was first proposed, for it disagreed with the then-dominant action-at-a-distance theories. But it was a genuine scientific field, rife with testable hypotheses and stunning new experiments, and very soon it swallowed whatever could be salvaged from the action-at-a-distance theories. The same can be said of all the scientific unorthodoxies that followed, such as Darwin's theory of evolution, Marx's criticism of capitalism, statistical mechanics, the two relativities, the two quantum theories, the synthetic theory of evolution, molecular biology, physiological psychology, and so on. All of these were, to borrow Isaac Asimov's apt expression, *endoheresies*—deviations within science—to be distinguished from *exoheresies*, or deviations from science. Endoheresy should be welcomed in science, exoheresy not. Tolerance, yes, but within science; there is no (intellectual) salvation outside it.

It does not follow that science lacks internal enemies. It does have them, but they are easily identifiable because they are nonscientific fragments that can be extracted without any loss to genuine knowledge. The most dreadful such fifth columns of science are excessive tolerance for ideas or practices that run against the grain of science (such as reading printed stuff without looking) and dogmatism, in particular the refusal to discuss matters of principle. Students of pseudoscience are currently divided about which of the two, pseudoscience or scientific dogma, is the more harmful. In my view the question is ill formulated and the usual way of handling it is nonscientific. The appropriate question is not just "Which is worse?" but rather "Which is the most harmful to whom and in what respect?" And the latter question should be investigated empirically rather than argued about, for it concerns factual matters; the problem is one for the psychology, the sociology, and even the economics of knowledge (and ignorance). Let me explain.

Presumably pseudoscience can do little harm to the scientific specialist, who is, however, constantly in danger of yielding to successful ideas and techniques—which, if taken as definitive, will end up by blocking progress. On the other hand, the layman, knowing little or nothing about the scientific orthodoxies of the day, is at the mercy of a number of superstitions, both those he learned as a child and those the mass media tout as scientific. Not being equipped to distinguish the genuine product from the fake, the layman is presumably more likely to buy the latter if only because he sees far more of it. (Besides the greater exposure, there is what William James called the will to believe. Many who embrace superstitions, old or new, do so because they feel the need for some extra support to face the struggle

for life.) In short, it would seem that, whereas scientific dogmatism is more harmful to scientists than to laymen, the latter have more to fear from pseudoscience.

Recyclable Rubbish or Virus?

Scientists and philosophers tend to treat superstition, pseudoscience, and even antiscience as harmless rubbish, or even as proper for mass consumption; they are far too busy with their own research to bother about such nonsense. This attitude is most unfortunate for the following reasons. First, superstition, pseudoscience, and antiscience are not rubbish that can be recycled into something useful; they are intellectual viruses that can attack anybody, layman or scientist, to the point of sickening an entire culture and turning it against scientific research. Second, the emergence and diffusion of superstition, pseudoscience, and antiscience are important psychosocial phenomena worth being investigated scientifically and perhaps even used as indicators of the state of health of a culture. Third, pseudoscience and antiscience are good test cases for any philosophy of science. Indeed, the worth of such philosophy can be gauged by its sensitivity to the differences between science and nonscience, high-grade and low-grade science, and living and dead science.

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