



Mountains, Sieves, and Science

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Science is concerned with *Data* - observations, evidence, nitty-gritty little facts. And science is concerned with lots of data - *mountains* of data. What is this Mountain made of? Things like - the elements of the periodic table, or fossils of many brachiopods, or melting points of compounds, or the names of all the stars, or the series of chemical reactions involved in digestion - and on and on. But this Mountain of Data is not in itself "Science." In the words of the great 19th-century scientist Jules Henri Poincaré, "*Science is built up with facts, as a house is with stones. But a collection of facts is no more a science than a heap of stones is a house.*"

So what *is* science? It's a *process*. Imagine that science is the act of using a sieve to sift through various explanations of natural phenomena. The explanations that work - the ones that help us understand that huge Mountain of Data - are kept in the sieve, and sifted some more (after all, the Mountain of Data is growing very fast). But the explanations that don't work - that conflict with too many pieces of data from the Mountain - fall through the holes of the sieve, and are discarded. Perhaps they can be sifted again, but they usually will require some improvements first.

This process, when carried out with energy and honesty, results in a set of truly effective explanations - validated bodies of knowledge, and the rules for understanding them - what we call the theories of science. But, this process is almost unique in all of human endeavor. In many other areas of society, such as politics, the law, and religion, there are mountains and sieves, but of a much different nature. Some discourses can even sound scientific, and yet be something completely different - pseudoscience.

What is this mode of thought which is as old as human nature itself? There's a Mountain and a Sieve again, but this time, the process is different. Here, the Mountain is the Explanation - the belief or view that is held as unalterable, unchallengeable, fundamental. And the items which are run through the sieve are - the *Data*. Data or evidence which supports the Mountain - the Explanation - are kept, while data which do not support the Explanation are quietly discarded. In the end, the practitioners of this art find themselves with a handful of Data that appears to strongly support the Explanation.

This process is ubiquitous in human society - it can be seen on the editorial page, in a political speech, or in a television commentary. It is even institutionalized in our legal system - the

prosecution presents just the evidence that will convict the defendant, while the defense focuses on any evidence that will exonerate their client.

Pervasive as it is, the practice of advocacy - finding the Data that supports a given Explanation - is simply incompatible with proper science. If an AIDS researcher looks at only the positive reports on a certain treatment - if he, for example, ignores reports showing the treatment can kill in many cases - then he is obviously not doing good science.

If a creationist claims that the transitional forms required by evolution do not exist, then that person is rejecting parts of the Mountain of Data - for example, fossils of *ichthyostega* or *archaopteryx* - that do not support his Explanation.

UFO believers who maintain that the evidence of an alien crash at Roswell is overwhelming choose to disregard the good, solid evidence that indicates the Roswell Incident was simply a mis-identified Army Air Force physics experiment. Psychics gloat about getting a few "hits," while ignoring their many misses. And so it goes.

Science is a very different way of looking at the world. And while some scientists may be a little proud or arrogant, the best scientists are always humble before Nature. In the end, it's not a single scholar, or a cherished belief, or a special book that has the last word in science. It's the Data - the Evidence. And that's how it should be.