Unobservable theories; hypothesis or fact?

Unobservable theories can be both hypotheses and facts. It is really a false dichotomy because there is very little in the world that is directly known or observable. Different scientists may be more interested in having their theories beyond argument, or having them intelligible, or they may just want people to think about it and make up their own mind. Sometimes there is a deeper argument going on underneath competing theories. However, any scientific theory is either useful or it is not and this is what determines its merit. That is my thesis.

People tend to think that what is directly observable is real. But things we think we are seeing or experiencing also depend a great deal on previous experiences and abstractions about them. For example, would someone who spent their entire life in a weightless environment, say underwater, be able to understand and adapt to gravity if he was hauled out onto dry land? As well, no one can know for sure that two and two make four without testing it. Gravity, and arithmetic nonetheless exist even if someone cannot or will not directly test them.

People use cell phones with no understanding of electromagnetism. People drive cars with no understanding of the Carnot principles. If we had to fully understand everything before we used it, we would be unable to cope. There is little that people know that they really understand; they just use what they know. They know it because it works predictably.

So, it is absurd to say that a scientific theory is invalid simply because it is unobservable. Yet it is also absurd to say that one is valid because it is a fact. A fact is a fact until it is no longer a fact. I am not going to support the idea that there are no scientific facts because everything that has been a scientific fact has been proven wrong. Nothing which actually solves a real problem is ever wrong. The problems just change over time. For example, some people think that Einstein's relativity theory disproves Newtonian physics. These ideas do not contradict each other at all and Newton's laws are as relevant as they ever were. Some people have the idea that the punctuated equilibrium theory of Stephen Jay Gould invalids Darwin. [1] No, it is a refinement of "natural selection" based on a century of further study of the fossil record and of living things. The 'laws' of motion and the 'laws' of evolution explain what they were intended to explain better than anything else that has been thought of since, and they are still the facts.

Put in other words, something is a fact if it explains something which cannot be explained any other way, or if it predicts how something works and can thus be applied to practical problems. This is so even if the thing cannot itself be directly proven, even if it remains merely a hypothesis. However, for a thing to explain anything people have to be able to understand it, it has to be intelligible. Ordinary people must be able to visualize how planets go around the sun, or how complex organisms evolve from simpler ones.

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[1] page 114. *Dear, Peter,* "The Intelligibility of Nature" University of Chicago press, 2006.

So, if a theory is not intelligible, it is worthless. All the theories dealt with so far in this course have been intelligible; that is why they have had success, that is why we are reading about them. This is true despite the different ways the scientists have of demonstrating their theories, and their different motives in putting them forward in a particular way.

Newton's Optics relies heavily on pre-algebra mathematics. He merely describes exactly what happened when he played with his prisms and colored paper. He invites everyone to duplicate what he has done, even though in some cases he admits he has not verified all of it.[2] It is possible for anyone with a little effort and scientific knowledge to follow what he has done, but if you are unwilling to do that, the propositions at the head of the chapters can be understood. The propositions and their proof can be readily put into plain language which uneducated people can grasp. They are not complicated.

There is a problem with Newton that he does things 'synthetically' instead of analytically. This means that he proceeds from "known to known", as in geometry, seeking to prove everything theoretically. This is considered a much more rigorous way of doing things, and also a slower way. It is questionable whether this is necessary, because scientists on the European continent had a different approach to physics than the synthesizing approach the British scientists took from Newton. It can be shown that these Europeans using an analytical approach, working from unknown to known, could solve problems

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[2] Page three of "Advertisement" Newton, Isaac, Opticks, http://books.google.ca/books?id=TwhbAAAAQAAJ&printsec=frontcover#v=onepage&q&f=fal se. Downloaded May 27, 2012

and develop new ideas faster. They were eventually well ahead of the British. Eventually the British started doing things in an analytical, algebraic way as well. Now the question is whether Newton's rules were any truer for having been determined synthetically rather than algebraically.

Lavoiser did it analytically. He played with his precision balance and his burned metals and applied algebra to the results. He found exact whole number relationships in the way elements combined to create molecules. He also wanted other people to reproduce what he had learned, even though most people could not afford his laboratory. He wrote a chemistry text book but he did not include in it some areas of chemistry which he thought were too theoretical, impossible to prove directly by experience.[3]

Lyell was concerned with how old the earth was and how it was formed. So he spent a lot of time hiking around the mountains looking at rocks, and he wrote a text book on the principles of geology. He thought the earth was very old and the layering of rocks was due to a cycle of mountains forming and eroding, washing into the sea, and being lifted up again. He did not think this changed much over time. He calculated an age of the earth of 70 000 years based on how long it would take the earth to cool down once it broke away from the sun, but it does not seem like he really believed that. He thought more in terms of many millions of years. He did not believe what were called Vulcanists and Neptunists, who thought the earth was formed by flooding or by volcanic activity, respectively. He thought that flooding and volcanos had an effect, but were not the main

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[3] page 74 *Dear, Peter,* "The Intelligibility of Nature" University of Chicago press, 2006.

cause of the earth's formation. Despite being a mentor of Charles Darwin, he did not adopt the idea that species evolve over time until the tenth edition of his text book. He thought that mammal fossils would be found eventually in the oldest rocks.[4]

Lamarck is often ridiculed as an example of a wrong idea that Darwin set right, or even suggested as an alternative to the Darwin theory by people trying to oppose it. What Lamarck actually said was that animal species lose body organs which they do not use, and develop ones which they do use. He said nothing about the exact mechanism by which this happens, and there is nothing about it which contradicts Darwin, or Mendel and his genetics, or Stephen Jay Gould. He did not have the information these others had, and his was the best explanation until better explanations came along.

This is what all four of the scientists I have looked at here, and their theories, have in common. They were all the best explanations possible at their times. They all tried to create a perfect theory which explained everything and they all failed, but the theories were useful in explaining, and pointed the way to further investigation. Newton's laws have never been challenged and are still used to calculate forces of gravity and inertia, as well as in optics. Lavoisier is more dated, but he still pointed the way to atomic theory and electrovalences, and taught a generation of chemists how to do research. Lyell got geology away from the idea that the earth was created suddenly and recently. He created the basis for further research into geology. Lamarck's work was the most theoretical yet still

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[4] page 252 *Baigrie, Brian* " Scientiific Revolutions" Pearson Prentice Hall 2004.

hard to refute because even in his time there were the results of human breeding of plants and animals for desired characteristics, creating what were in effect new species.

All these scientists and their theories had a deep argument going on with older established ideas and with critics. Newton wanted to distinguish himself from Aristotelean scientists who distained mathematics. His work was criticized as being so mathematical it was unintelligible. Lavoisier wanted to distinguish himself from the alchemists. He was criticized that his work depended on expensive equipment and so other researchers could not duplicate what he did. Lyell and Lamarck had to defend against creationists and the charge of being too theoretical.

These people's ideas, or what developed out of them, are in use today because they worked, they explained, they predicted; not because they were 'proven facts'.