

The Top Ten Scientific Advances of All Time

Recently I was looking through a bunch of old science magazines before tossing them out. Most were from way back in the 1990s, but one was more recent: The Jan. 2, 2010 issue of *Science News*, which summarized the most important science stories of the previous year. Most intriguing, however, was the introductory note by the editor of that magazine, Tom Siegfried, entitled “The Top 10 science news stories since time began”. His list is below, though he presented them in backwards order (a la Dave Letterman); personally I think the most important things should *come first!*

Tom Siegfried’s list of the “Top 10 science news stories since time began”

1. **Planck** conceives quantum theory, 1900.
2. **Maxwell** figures out electromagnetism, 1864.
3. **Newton** derives law of gravity, 1687.
4. **Leucippus & Democritus** decide that matter is made of atoms, fifth century B.C.
5. **Watson & Crick** elucidate DNA’s double helix structure, 1953.
6. **Copernicus** concludes that Earth is not at the center of the universe, 1543.
7. **Darwin** deduces the mechanisms of evolution, 1859.
8. **Hubble** discovers that the universe is expanding, 1929.
9. **Galileo** explains the principle of relativity, 1632; **Einstein** expands its implications, 1905.
10. **Hahn & Strassmann** discover nuclear fission, 1938.

Note that Siegfried’s list is heavy on physics and ignores many other sciences completely. In particular there is *nothing* that might count as social science! I don’t actually object to that in a bourgeois journal, because—after all—everybody knows that bourgeois “social science” is really not very scientific! Even within physics Siegfried’s ideas of the most important advances seem rather skewed to me. Surely quantum mechanics is not more important than the basic theory of atoms, for example! Siegfried also focuses too much, for my taste, on the specific contributions of particular individuals at specific times.

Anyway, I did like the game he was playing, but felt I could do a better job of it! (Well, at least a rather *different* job of it.) You might like to play this game too!

My first flippant ideas were rejected by my wife; she disagreed that the inventions of the revolver and the flush toilet deserved to be mentioned in the top 10 scientific advances of all time... So I did put a bit more thought into it.

Below is my list of the “Top Ten Scientific Advances of All Time”, as viewed from what I take to be the appropriate perspective of human beings on the planet earth, as of the year 2010. I start with two basic

principles that have been abstracted from *all* the sciences, namely scientific materialism and dialectics. But I've also elaborated on many of the advances in my list to a greater degree than Siegfried did. And what I count as advances are actually often more like broader general theories than the specific items that he mentioned.

My List of the Top Ten Scientific Advances of All Time

(From the appropriate point of view of human beings on planet earth, as of 2010.)

1. **Scientific Materialism:** The conclusion that matter is primary and that mind is a set of functional characteristics of certain complex forms of matter (brains). (Or, expressed differently, that mental phenomena are internal high-level characterizations of some of the things that the brain is *doing*.)
 - a. Corollary: Disembodied minds, including “gods”, cannot exist.
2. **Dialectics:** Especially the central proposition of dialectics, that dialectical contradiction (opposition) exists in everything, and that the struggle of opposites leads to change and development.
3. **Evolution:** The conclusion that humans and animals have naturally evolved, and the basic mechanisms for how that has occurred, including natural selection and the basic principles of genetics.
 - a. Corollary: That life first developed from non-living chemical processes.
4. **Historical materialism:** The principles...
 - a. That human society and history can be understood scientifically.
 - b. That, however, material production is the basis of social life, and that social consciousness is the result of social being.
 - 1) That people tend to believe that which is in their own material interests to believe.
 - 2) But that the dominant ideas of any age are those of the ruling class.
 - c. That society and history are made by the people, by the masses of human beings.
 - d. That, however, the prevailing mode of production conditions and sets limits to the changes which can be made in society at any given time.
 - e. That human society is composed of social classes defined primarily by the relationships of different groups of people to the means of production.
 - f. That the history of society, since classes first developed in ancient times, is the history of class struggle.
 - g. That “at a certain stage of their development, the material productive forces of society come into conflict with the existing relations of production.... From forms of development of the productive forces these relations turn into fetters.” (Marx)
 - h. That “at that point an era of social revolution begins.” (Marx)
 - i. That society must ultimately progress to the stage of communism where classes have ceased to exist.
 - j. That between capitalism and communism there must be an intervening transition period (socialism), which can only be the revolutionary dictatorship of the proletariat.
5. **The invention of agriculture and settled life** (“civilization”). Includes many subsidiary aspects such as technical advances in farm implements, the domestication of plants and animals, etc.

6. **The conclusion that the earth is not the center of the universe.** Corollaries include:
 - a. Understanding the basic organization of the solar system (with the sun at the center).
 - b. Understanding the basic organization of our galaxy (the Milky Way), with our solar system on the outskirts.
 - c. Understanding that there are vast numbers of other galaxies, clusters of galaxies, etc.
 - d. The discovery that the observable universe seems to be expanding, and the later discovery of the cosmic background radiation, etc. (Things which are summed up, and usually falsely extended in a religious way in what is called the “Big Bang Theory”.)
7. **Atomic theory:** The conclusion that matter is composed of discrete particles. Corollaries:
 - a. The whole scientific sphere of chemistry!
 - b. The recognition that the probabilistic “wave aspect” of certain collections of matter is a useful way to look at them, though it is conceptually secondary to the particle aspect. (Cf. the theory of gases, thermodynamics and quantum mechanics.)
8. **Concepts of physical forces and energy:** Sub-areas include
 - a. Gravitation: Our theory of gravitation as developed especially by Newton, but also before him by Galileo, and after him by Einstein. (Also included here would be the invention of calculus by Newton and Leibniz.)
 - b. Electromagnetic & atomic forces: Especially Maxwell’s equations, and later quantum electrodynamics, etc.
9. **Cells:** Our general conceptions of biological cells and how they function. (Most of the explanation of how living things actually function requires explanations in terms of various types of cells.)
10. **Computers:** The creation of what are (so far) very crude artificial brains.
 - a. Corollary: Advances in solid-state physics, especially the invention of transistors and integrated circuits.

If I could add a few more items they might be things like:

11. **Plate tectonics:** The basic organizing theory of geophysics.
12. **Basic linguistic theory:** Analysis of language in terms of phonemes, morphemes, word classes, etc.
 - a. Corollary: The discovery that human languages are related to each other in regular ways.

You will note that except for a brief mention of calculus I have slighted mathematics. (Although mathematics is highly *useful* in science, it itself is not actually an investigation of the physical or social world.)

On the other hand I have not only included the foundation of genuine social science, namely *historical materialism*, but spelled out a number of its principles—because experience has shown that most people have little idea what it is actually all about. Of course my inclusion of historical materialism in the list, as well as scientific materialism and dialectics, makes my list inherently contentious in present-day society!

Note also that some of the specific items later in the list may actually be viewed as instances, of a sort, of the more abstract advances listed earlier. Thus the atomic theory is a type of materialist theory, and the cell theory is sort of an atomic theory applied to animal and plant physiology.

In most cases I have not bothered to mention the individuals most responsible for these scientific advances, since that is either well known or else a complicated story.

If anyone has specific criticisms of my list, or suggestions for changes to it, by all means let me know!

Scott
(4/22/10)

Addendum (4/26/10): I should have explicitly mentioned the tacit principle that it seems I was semi-consciously using in constructing the “Top Ten” list above. Most areas of science, at least once they have reached a fairly high level of development, have what are known as “central organizing theories”. A *central organizing theory* is the core theory for that area of science. In geophysics, for example, the central organizing theory is plate tectonics (as I mentioned above). But pretty much all the other top advances in science also amount to the elaboration of various other central organizing theories for their respective areas of science.

Evolution and the principles of evolutionary science constitute the central organizing theory of biology. As the evolutionary biologist Theodosius Dobzhansky remarked: “Nothing in biology makes sense except in the light of evolution.” (Dobzhansky fully recognized this even though he himself was a Russian Orthodox Christian.)

In physics, the theories of atoms and forces form the two central organizing theories, and once again pretty much all of physics and chemistry is inexplicable except in terms of these central theories. With regard to the central importance of the theory of atoms and the forces between them, Richard Feynman put it this way:

If, in some cataclysm, all of scientific knowledge were to be destroyed, and only one sentence passed on to the next generations of creatures, what statement would contain the most information in the fewest words? I believe it is the *atomic hypothesis* (or the *atomic fact*, or whatever you wish to call it) that *all things are made of atoms—little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another*. In that one sentence... there is an *enormous* amount of information about the world, if just a little imagination and thinking are applied. [Feynman’s *Lectures on Physics*, p. 1-2.]

In social science, *historical materialism* is the central organizing theory, and very little in society makes any sense except in terms of it. The fact that (for ideological reasons) so few people today are at all acquainted with historical materialism thus explains why so many are utterly perplexed by what is

happening in the social world all around them. Society, rich & poor, economic crises, politics in general, international wars, and so forth, are all quite mysterious to them because they lack this central organizing theory to make sense of it all.

In modern cognitive psychology the central organizing theory is that mind and mental processes are aspects of the functioning of the brain. But more than that, the first two items on my top ten list of scientific advances of all time (namely scientific materialism and dialectics) pretty much constitute the central organizing theories of science in general!

My overall claim here with regard to this list of the greatest scientific advances is just this: The most important advances of all have simply been the creation and elaboration of the central organizing theories in the major sciences, and for science as a whole.

—S.H.