Letters, and some replies, on “One hundred years since Einstein’s annus mirabilis”

25 July 2005

I found your articles on Albert Einstein the most comprehensive I have come across regarding his contributions to modern scientific thought, the debate over quantum mechanics, and the theory of relativity. Sadly, it seems, most science teachers lack the understanding themselves in trying to convey these ideas and the views they challenged and inspired to their students, not to mention the excitement that modern science should and can engender in all of us.

As I understand it, Einstein was a man profoundly affected by the times in which he lived as well, not living in an academic cocoon, but greatly concerned by the human condition, the rise of fascism, and the morality or lack of it over the use of atomic weapons. Could you possibly follow up this very fine article with Einstein’s insights as well as his limitations in the realm of politics? For example, I understand that due to his support for civil and democratic rights, there was extensive spying on him done by the Federal Bureau of Investigation (FBI). This seems to have intensified especially after he wrote articles in support of civil rights, the Spanish Republic’s struggle against Franco (early 1937, I believe), and so on.

There is so much that we working people could learn from our educational institutions that are being systematically dismantled and purged of books, alternative solutions to problems (like socialism), and an enlightened curriculum. It occurred to me that this, then, is the whole point of the attack on knowledge—to deny the working class the fruits of thought and knowledge of humanity, as well as of production, by the capitalist class.

GC
San Jose, California
July 15, 2005

Just thank you and WSWS for your series of articles which I will save and fit into my life long fascination with E=mc2 and your article brought up the modern issue of differences with quantum mechanics that hasn’t been presented to this layman before—and now even more a subject of personal interest and enjoyment too.

GH
United States
July 14, 2005

I read an article in the *Guardian* a few months ago which claimed that the speed of light is slowing down. At the time I found the concept fascinating, but didn’t bother to look into the matter any further. Then I started wondering if it had been an April Fool’s joke. A few days ago I finally decided to look into the issue again.

I searched “speed of light is slowing down” on Google and found a few interesting story lines in addition to the *Guardian* piece. The August 8, 2002 edition of *Nature* reportedly contains an article by Paul Davies, a theoretical physicist at Sydney’s Macquarie University, making such a proposal. In July 1987 Barry Setterfield and Trevor Norman published an article in SRI (?) indicating that the results of speed of light measurements throughout history demonstrate it is slowing down. Several other papers have also been written on this subject—as well as on the ability to slow down the speed of light, even to one foot per second.

While some of these articles appear to be based in science, others use the concept of the speed of light slowing down to confirm biblical concepts of time. A faster speed of light at the time of creation means all scientific measurements of time are incorrect (so the universe could be 6,000 years old). Setterfield is often referred to as a creationist. Other articles indicate a faster speed of light at the time of the big bang adds better scientific explanation to the universe. All say that a slowing of the speed of light contradicts Einstein’s theories.

I was hoping you would address this issue in your article. Since you did not, perhaps you could. Obviously, I am not a scientist. To me the alleged ability to slow down the speed of light to a trickle in a lab and the reports of slower light speeds through water indicate that the speed of light can be manipulated and, therefore, is not constant. I also keep thinking about an explosion and how, in my mind at least, particles would seem to move faster immediately after the blast than they do after radiating out—making me think that the speed of light could be slowing down (although I’m not sure that is a particularly logical argument).

The concept is intriguing because it questions accepted belief—which could mean new scientific understanding and advances. It could also be a hoax: creationists certainly appear to have jumped on the idea. Hopefully, you can shed some light.

Thank you,
MB
Portsmouth, Ohio
July 16, 2005

Peter Symonds replies:

Your question touches on a fascinating area of current research into whether certain fundamental physical constants, such as the speed of light, have varied over time. The short article that you cite from the *Guardian* underscores much that is wrong with science reporting in the mainstream media: it is superficial, explains nothing and highlights the sensational, based on the assumption that no one could possibly be interested in anything else.

Fortunately, I happened to be reading a very interesting article in the June issue of *Scientific American* entitled “Inconstant Constants” by John Barrow and John Webb dealing with precisely this research. It reports in detail on the findings of the two authors, and associated physicists at the University of NSW in Sydney, that what is known as the fine-structure constant (alpha) may have changed since the beginning of the universe. The article describes the result as “extraordinary”, and it is, but the change involved is infinitesimal: six parts in a million over the past six billion years.

The technique involved a very accurate method of examining changes in the spectra of light coming from very distant astronomical objects known as quasars. The fine-structure constant was a particular target of investigation because, unlike a number of other constants, such as the speed of light (measured in metres per second), it has no units. It is the ratio of other constants, including the speed of light, in which physical

variables such as mass and length neatly cancel each other out. The importance of this is that it ruled out the possibility that any changes may also be affecting the standard measures of units.

The results, according to the article, are still not conclusive. If correct, it may mean that one or more of the constants that contribute to the fine-structure constant, including the speed of light, may also have been changing over the same time period. It certainly would not lend any credibility to the claims of people like Setterfield. The changes in the measurement of the speed of light stem from the fact that vastly more accurate methods are used today as compared to the first efforts of Roemer in 1676. Moreover, if Setterfield claims that the speed of light has changed dramatically enough to account for a universe just 6,000 years old, it is almost certain that he hasn't bothered to work through the many bizarre implications that would inevitably flow from such a conclusion.

If it turns out that the speed of light has changed, then it would not "demolish" relativity theory or demonstrate that it is "wrong" as the *Guardian* article implies. Rather, it would demonstrate what physicists have known for some time: that general relatively and quantum mechanics are partial theories that will eventually be subsumed into a more all-encompassing theory. It may provide an important clue to theoretical physicists involved in the task: superstring theory, for instance, allows for the possibility that constants such as the speed of light may change over time. Changes to the fine-structure constant also have implications for cosmological theory, as it (the constant) relates to the strength of electromagnetic forces and thus variations would affect the structure of atoms.

Just a couple of final points. When physicists speak of the speed of light, it is shorthand for speed of light in a vacuum. It is well established that light slows as it passes through water or other transparent media. This is the reason behind the bending or refraction of light. Finally, I am not quite sure what you are trying to get at with your example of the explosion. There is certainly no way of detecting any changes in the speed of light from ordinary observation.

I much appreciated your scholarly exposition ... a far cry from the quantum quackery which disfigures recent pages of *Nature*.

"... There is another benefit of seeing the world as quantum mechanical: someone who has learned to accept that nothing exists but observations is far ahead of peers who stumble through physics hoping to find out 'what things are'... The Universe is immaterial—mental and spiritual. Live, and enjoy..."

Essay

Nature 436, 29 (7 July 2005)

"To regard truth as an instrument of cognition means, in effect, to go over to agnosticism, i.e., to abandon materialism."

V.I. Lenin, 1910

WS

United States,

July 14, 2005

Peter Symonds replies:

As you are no doubt well aware, it would be relatively easy to multiply the article you cite from *Nature* into a small, perhaps even a large, mountain of quantum quackery. A lot of it can be traced back to the interpretation placed on quantum mechanics by Bohr, and the even more openly philosophical idealist conceptions of Heisenberg. The article's prominence is also a sign of the times. All manner of philosophical reaction is being openly promoted, not only of the extreme right, but also from the post-modernist "left".

Not too many people would so appropriately quote Lenin. His *Materialism and Empiro-Criticism*, which is a masterly defence of materialism—the essential philosophical base of all science, natural and social—is much maligned, including by many who claim to be Marxists. Among physicists, it is barely known. Those who have read it, either dismiss it, misunderstand its purpose or treat it as an interesting historical footnote. This state of affairs can be traced back to Stalin and his heirs, who, among their many crimes, appropriated and perverted Lenin, including his philosophical writings, so that few scientists would think of turning there for answers.

Thank you for your exceptionally clear coverage of Einstein's achievements and his influence on physics. I look back on my own career as a "hard working" physicist, not one of the "stars" like Einstein, Fermi, etc. Coming out of graduate school in 1964, I thought, as did, and do, most other physicists, that nothing can travel faster than the speed of light. Subsequently I had some mundane assignments. One of these was to develop software for the determination of trajectories of spacecraft under the influence of objects in orbit around the sun. To my initial horror, the determination of these trajectories depended on the instantaneous positions of the far-flung masses. In other words, no matter how far away the massive objects (Earth, moon, Mars, etc.) the effects of their motions on the spacecraft, and each other, were apparently transmitted infinitely fast. Newton seemed to be right, at least about gravity. Astronomers know this, but make no big deal of it. I consider it to be the elephant sitting in the corner of the living room.

Consider the following "Gedanken" situation: Two massive bodies are orbiting around each other under the influence of gravity. Assume that they are cold enough to not be radiating. On one of the bodies, call it the first one, there is a single radioactive atom that suddenly emits a photon. The first body therefore suddenly lost mass, which would necessitate a change in the orbits of both bodies. If the change in mass of the first body is not instantaneously transmitted to the second body, but delayed by the need to travel at the speed of light, the gravitational effect would effectively become non-central. This would lead to an anomalous change in angular momentum and energy of the two-body system that could not be accounted for by recoil effects of the emitted photon. Must we sacrifice energy conservation (except for Heisenberg fluctuations about the mean) on the altar of the subluminal speed mandate? Suppose we assume that "information" can travel at the speed of light (my personal working assumption). Then, if a purely gravitational system has no new "information" perturbing it, the forces will seem to be transmitted instantaneously. Under these assumptions, "something else" that connects quantum mechanics and gravity has to be happening when that photon, representing electromagnetic "information", is emitted.

Time will tell whether string theory can be the connection. My point is that quantum mechanics and relativity are analogous to parts of the elephant the blind men of the fable experience. They are not wrong. Einstein wanted to find the rest of the elephant. Like the blind men, we human beings have to keep groping without prejudices to connect and understand the parts of the entire elephant. I am becoming more and more pessimistic, however, about how future advances will break through ossified thought patterns and religious prejudices, or if even mankind will survive its phase of backward thinking long enough to explore the rest of the elephant.

JN

Glen Mills, Pennsylvania

July 14, 2005

Peter Symonds replies:

Not being a working physicist, it was not clear to me exactly what calculations you were making regarding spacecraft trajectories that would require that the effects of massive objects, such as the Sun, would act instantaneously in violation of relativity theory. One of the initial confirmations of general relativity was its application to the orbit of Mercury. Einstein was reportedly ecstatic when he discovered that his theory could explain a well-known anomaly that could not be explained by Newtonian mechanics. Likewise, your thought experiment is difficult to follow.

However, the general point that you make is certainly correct. The incompatibility of two very successful theories—general relativity and quantum mechanics—has to indicate that a broader synthesis is both necessary and possible. Einstein certainly would have appreciated the fable of the blind men and the elephant. If he was guilty of anything in the debates in the 1930s and 1940s over quantum mechanics, it was in insisting on a materialist approach (philosophically speaking) to science and in not accepting partial theories as the final answer.

As to the fate of mankind, we understand, but do not share, your pessimism. The extraordinary evolution of physics in the twentieth century is just one indication of the capacities of humanity. If physicists can plumb the depths of the atom and measure astronomical phenomena hundreds of millions of light years distant, it is certainly possible to reorganise society along socialist lines to provide for the basic social needs of all. The precondition is the liberation of mankind from the shackles of a social system dominated by private ownership for profit, the anarchy of the market and an irrational division of the world into nation states. While in no way minimising the difficulties involved, we are seeking to build an international political movement committed to carrying out that task.