

**From:** "Al Seckel"

**To:** "Jeffrey Epstein" <[REDACTED]>

**Subject:** Your latest blog, but I had to post something in your name, which uses it repeatedly. I just knocked it out, and of course, is in my voice, and based a lot on my extensive conversations with Feynman on this subject in the early 80s.

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## Jeffrey Epstein on Quantum Computing

The late theoretical physicist Richard Feynman stated, "It is a part of the adventure of science to try to find a limitation in all directions and to stretch a human imagination as far as possible everywhere. Although at every stage it has looked as if such an activity was absurd and useless, it often turns out at least not to be useless."

Feynman stated this in a memorial lecture he gave in 1985 titled "Computing Machines in the Future." It is perfectly appropriate to start my blog on quantum computing with a quotation from Feynman, as he is universally regarded as the "father of the quantum computer." Feynman had profound and prescient insights into the physics of quantum computing as well as the field of nanotechnology. It should be noted that Feynman, however, wasn't the first to think of an idea of a quantum computer, such a notion was explored previously by various physicists and computer scientists in the mid 1970's and early 1980's, such as Charles Bennett, Paul Benioff, and David Deutsch. However, Feynman was notorious for not reading the work of others, and tending to work out first principles on his own.

Feynman knew that Moore's Law indicated that if technology were applied to the size of circuitry on silicon chips, eventually one would reach a point when classical physics would no longer apply, and one would have to work in accordance with the principles of quantum mechanics.

It was in 1982 when Feynman first came up with a theoretical approach of how computation could be achieved on a quantum mechanical level. He first approached this problem by establishing what were the limits of physics on computation. Secondly, why was it that when we wanted to do a hard problem a little better, it always seemed to need an exponentially greater amount of computing resources? Third, he was interested in how the perceptual process worked, and was interested if there was a way that this could be applied to the second question. David Marr's book on vision had just come out, and so, this was a topic that he had some great interest in pursuing. He even co-taught a course at Caltech with MIT's Gerald Sussman titled the "Potentialities and Limitations of Computing Machines." This allowed him to explore the notion with his fellow Caltech colleagues (John Hopfield, Carver Mead) and a small select number of his students (Eric Mjostness, Mike Douglas, and Al Seckel) on the ultimate physical limits of computation and the computational aspects of physics. Specifically explored were the ideas of Rolf Landauer on physical information, Ed Fredkin on reversible computation, Tommaso Toffoli on how physical action measures the amount of computation, Norman Margolus on cellular automata, and Charles Bennett on quantum information theory. Feynman was particularly interested in what ideas related to the reversibility of computation and what that could mean physically. Out of these

discussions, Feynman worked out and designed a computer based on a mathematically precise Hamiltonian, where quantum properties could be used to represent data and perform operations on these data. A number of his people in his inner circle of colleagues and students tried to point out to him at the time that this approach was “over simplified,” and that he might have oversimplified the problem away, i.e., problems concerned with noise and the fact that the laws of physics would not allow such a precise Hamiltonian computer. Feynman would not have much of such criticism, preferring to stick to a purely theoretical precise first approach. After a particularly brutal argument with Seckel, over such ideas in a pre-print article, and backup from Mjolsness and Douglas, Feynman agreed that his approach might have been oversimplified.

While all this was theoretical, the idea was one that was starting to catch on. In 1985, David Deutsch published a seminal paper that Feynman’s approach could eventually lead to the computation of any physical process modeled on quantum mechanics, and thus have efficiency capabilities far beyond any classical computational computer. Deutsch introduced the idea of “quantum logic gates” as a means of controlling the quantum process. As Feynman’s approach was purely theoretical, he had not concerned himself with the notion that N scaling would produce better results, but only that the size and scale of computers were not limited by classical physics. It was Deutsch’s paper that turned Feynman’s theory into something that was worthy of serious investigation, and it is one that has captured my own attention and the support of the Jeffrey Epstein Foundation, as well as that of many others.

While there have been many advances in quantum computing, including now the design and completion of some two- and three-qubit computers, which can do very simple arithmetic and data sorting, there are still some very large obstacles that remain to be solved from building any quantum computer that will even remotely rival a desktop computer. The problems that I am particularly interested in, and of course, many others, in seeing solved are in the areas of :

**Entanglement and Decoherence**, the tendency of a quantum computer to decay from a given quantum state into an incoherent state as it interacts, or entangles, with the slightest state of the external world, with which it acts continuously. For example, with the surrounding photons that then create the visual experience within the observer, which typically consists of a large number of degrees of freedom that are hardly ever fully controlled. This is basically at the heart of the problem, because before any quantum computer can achieve meaningful results, such as those in complex problem analysis, we must be able to solve how to maintain decoherence and reduce potential sources of error. So, how can we have error correction? Right now, there are some new possible paths to explore, such as new methods of isolating the system from its environment or with new types of quasi-particles, such as anyons, and recently people have been exploring quantum computing photosynthesis, all which are finally offering some hope, the latter is particularly interesting to me, as photosynthesis achieves its enormous efficiency through quantum computing algorithms, a process that involves finding the best route for shifting energy from light-absorbing molecules to the photosynthetic reaction center, where it is used to drive chemical reactions. Once again, nature has figured out through millions of years of evolution how to do things efficiently. Always look to biological models.

The physical requirements of manipulating a system on this quantum scale are enormous, and recent approaches utilizing superconductors, nanotechnology, and quantum electronics, as well as biological systems, are bringing hope that a large-scale quantum computer will eventually be built. The fundamental theory is sound.

Of course, there are also large-scale problems with architecture of such devices, but I will concern myself here with only the theoretical. Another area that the Jeffrey Epstein Foundation has been actively interested in supporting is in quantum parallelism, specifically in the work of David Deutsch, previously mentioned. A quantum computer would be able to perform multiple computations on its own by utilizing the fact that the [qubit](#) exists in multiple states simultaneously (a key feature of quantum physics is the ability of the quantum wave-function to exist in multiple states at the same time). This gives a quantum computer much greater raw computation ability than a traditional computer. However, we need to solve that problem of quantum coherence previously mentioned, as it is the superposition of many quantum states that will allow many calculations to be performed simultaneously.

Quantum computing offers great hope in the ability to solve many complex problems far beyond the range of present day computers. It only contributes efficiency, not insight, to the computing process. It also has enormous ramifications for both cryptography and encryption. There are some who fear that a real practical quantum computer could severely damage the world's financial systems, which are all based on current security encryption methods not solvable by modern computers or supercomputers. A quantum computer could crack such huge numbers in a only a few nano seconds. As with any advance in technology, comes new dangers we have to think about.