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*The Tower of Babel (8/26/2009)*

[In re improvements in computer security:]

... Having thought about it a bit, I've decided that your idea of writing another operating system is exactly the right one, with the following variation: what you really need to do, in this situation, is what the Lord did when he halted the construction of the Tower of Babel by confounding the languages of the earth — i.e., it would be best, really, if you could ensure that every computer had a different operating system, or at least slightly different anyway. Though at first blush the idea seems preposterous, I don't think it is: the key would be to grow them, essentially, and for a variety of reasons I think this is the future of software in any case. Some research would be necessary to perfect the technique, but since the alternative using traditional methods would be (as was done with Unix) to write something from scratch and then spend a couple of decades ironing the bugs out of it — training a new generation of hackers in the process — I think it's obvious that a new approach is required anyway. Moreover note that even if, in analogy with biology, you anticipate that what you end up doing is generating slight variations on some small set of templates a la variations in the genetic code, already you guarantee the kind of robustness in the population that ensures that no single virus, e.g., can successfully attack everything at once, and that there will always be a subpopulation with natural resistance — which we can by the usual Darwinian mechanisms expand to replace the individuals vulnerable to disease.

This may sound vague, but it isn't. It is established that you can program a system to solve formally well-defined design problems automatically, and that the solutions have the required characteristics that [a] they exhibit a large degree of random variation and [b] that they are as good or better than the solutions human engineers can devise. If circuit design, e.g., then why not an OS? really, I think it

should be possible. — Communications protocols might still have to be standardized, but, again, it's possible that we could introduce a considerable degree of Balkanization into this as well, without making it impossible to transmit information — and, nota bene, what we're all agreed upon is that communication at this point is too easy. — Remember also that we really don't have to know the details of the mechanisms and protocols thus generated, indeed the more black boxes the better; it just all has to work somehow, and we have to be able to make sense of bits and pieces of it as necessary when [as occasionally must transpire] something has to be fixed by hand. [It has already been several years since I read of the example of a guy at MIT who grew neural networks to solve simple problems for him and then spent all his time taking them apart to try to figure out how they worked — and thought: this is the future of programming; not engineering, but biology.]

... This would, obviously, be easier to do if programs were well-defined in some specification language which provided an exact description of their behavior; this would provide a means of independently proving their validity, of course, one of the desiderata of theory at least since the Fifties, but, more to the present point, would also allow the possibility of as it were defining the behavior of a black box and then allowing some kind of organic (at least nondeterministic) process to grow whatever is inside it. The immediate application would be to the email clients, pdf readers, etc., which provide routes through the firewall, but the same principle could be applied to the operating system itself.<sup>1</sup>

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<sup>1</sup> In more recent developments the NSA has indeed proposed to write a new OS, codenamed Wyvern, doubtless destined to become another of these Swiss Army knives the military-industrial complex excels at producing, which is predictably intended to increase security by reducing diversity, exactly the opposite of the correct approach. Against stupidity even the gods contend in vain.

.... Besides rendering it more difficult for one attack to bring down everything at once, it seems to me that introducing biological variation into operating systems should make it easier to trace the origins of malign code; there ought to be a sort of watermark, i.e., which would identify the type of system on which it originated. Like a DNA trace, or (a cough behind the hand) the variations in isotopic composition that make it possible to deduce the source of the nuclear material used in a bomb.

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... when the gametes for two sexes fuse to form a new individual, the chances for variability are extremely large. This variability is highly valuable to multicellular organisms which reproduce sexually, not only because variability is the raw material of evolutionary adaptation to changes in the environment, but also because the great variability of sexually-reproducing organisms makes them less likely to succumb to parasites. Infecting bacteria might otherwise deceive the immune systems of their hosts by developing cell-surface antigens which resemble those of the host, but when they infect sexually-reproducing organisms where each individual is unique, this is much less likely.

— Avery, *Information Theory and Evolution*.<sup>2</sup>

Or, put succinctly: since our computers are already fucking one another at every opportunity, we need only ensure that these unions prove fertile.

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<sup>2</sup> John Avery, *Information Theory and Evolution*. Singapore: World Scientific, 2003; p. 98.