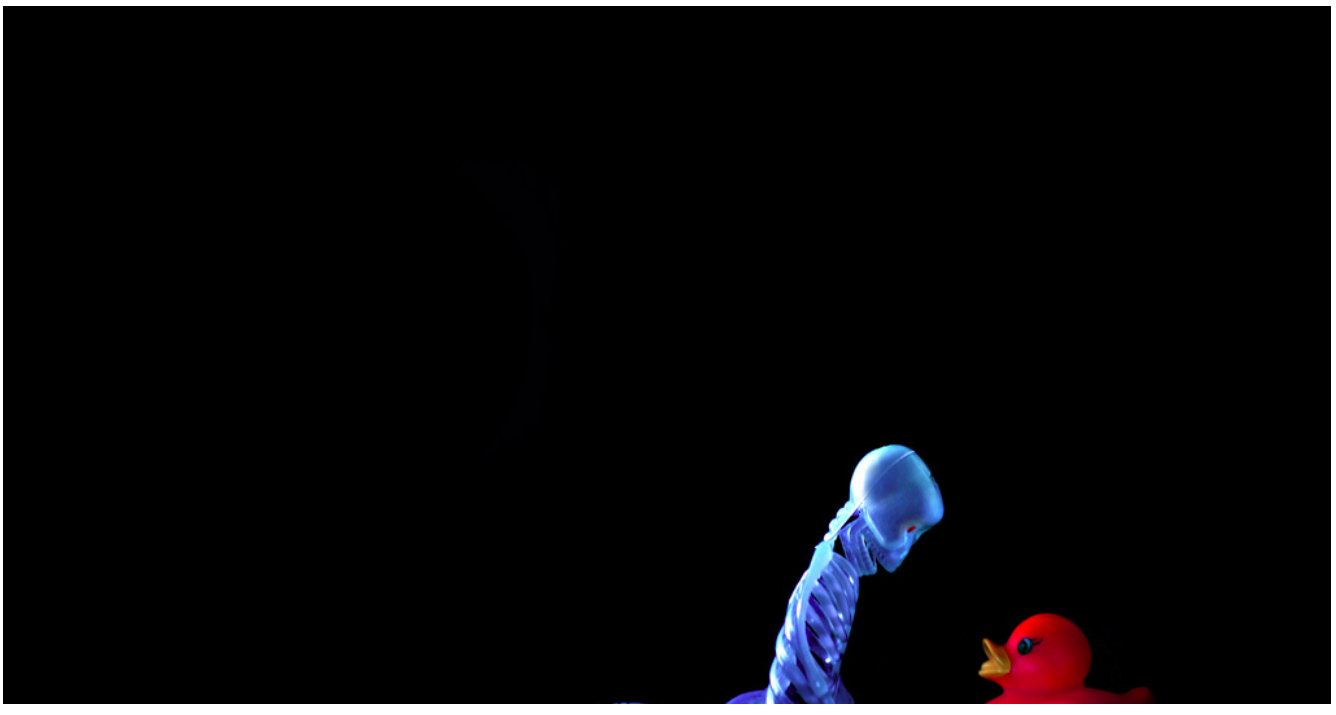
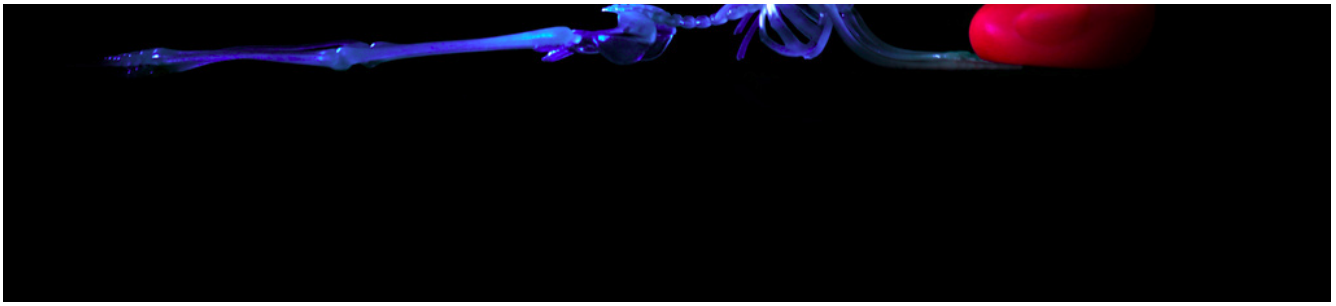
BACK OF THE ENVELOPE

To Live Forever

By F. C. BROWN CLOUD | 08 NOV 2016





"Forever" courtesy of Aftab Uzzaman

The animal facility in the basement of Pasteur has a room always gurgling with the sound of large, well-aerated aquaria. The lobster room. One per tank are seven lobsters, each over fifty years old. The eldest is fifty-six. They were hatched in captivity and have never left these tanks.

The glass walls provide an isolated, safe environment for each. As with humans, long-term confinement in close proximity would've led to violence. Perhaps the septet could've endured a few years peaceably in one large vat, five years, ten, but after five full decades it's nearly certain that at least one would've been rent asunder and ingested by another of its kind.

These lobsters are maintained by grant money through the biology department's Lifespan Initiative, a multi-lab consortium that includes developmental biologists, ecologists, a geneticist specializing in microarrays, and our man Dr. Ostentane, an as-of-yet untenured rising star who's been making heady progress with his cybernetics work. His lab doesn't do anything with the lobsters. Dr. Ostentane just has to sit through a few lobster talks every year during the Lifespan Initiative annual retreat.

Lobsters, it's been surmised, might never die. But this is difficult to verify because there is no good way to accurately measure a wild lobster's age. And because, of course, lobsters in the wild *do* die. Most become larger over time, and although that bulk might increase virility and thus be positively correlated with reproductive fitness, big lobsters move slowly and are less adept at hiding under rocks. The predominant predator for adult lobsters is a voracious species of hairless terrestrial ape, against which an elder lobster's size and claws and carapace are ineffectual defenses.

And there are other possible demises to which a wild lobster might succumb. Asphyxiation from a bad case of gillstone. Hyperthermic exhaustion if trapped in one of those warm ocean currents that've been eddying unpredictably in our modern climes. A loss of faith while molting. It's hard work, cracking out of those giant exoskeletons, and some lobsters cease writhing midway through, crumpling to the ocean floor tangled and exposed to await death in a seemingly depressed malaise.

This last bit is speculative: the DSM 5 provides no guidelines for lobster diagnosis.

But it might not be *inevitable* for a lobster to die. Their chromosomes are capped by telomeres that do not shorten over time. The lipid compositions of their cellular membranes seem time-invariant as well. At a molecular level, they do not age. The seven lobsters maintained through the Lifespan Initiative are very large, but in other ways they can hardly be distinguished from the lobsters they were in youth. Years pass and they do not change.

Their circumstances change. Graduate students change. The individual students who've tossed in their feed have varied over the years, always new ones wearing freshly outdated styles of clothes. Sometimes dark-skinned ones these days. Many with oleoconvex chests. Years ago the graduate students were all pale and male.

And the view from within the tanks has changed. The lobsters have been moved twice in the past fifty years, first from the original biology building to the "new" biochemistry center built in the 1980s, then to their current residence in the basement of Pasteur. Nobody knows whether lobsters care what they see outside their aquaria. Even if they do, they might've failed to appreciate their former view from the fourth floor of the biochemistry center, that sweeping vista of blue sky meeting blue lake with green-leafed trees in the foreground. Lobster eyes show most visual discrimination in a range of wavelengths almost too red for humans to see.

For lobsters, for these aquaria-sheltered seven in particular, time drags on and on and they thrive. Well, survive, at least. They're often poked and prodded and subjected to various physical exams to assess their health. So far, the years have left them undiminished. Which is not true for the humans who've worked with them. For humans, time passes and the body begins inexorably to fail. Human telomeres taper into nothing, incompletely duplicated with each cellular division, and once the telomere is gone coding regions can be lost. Information dribbles away. Often the losses do not matter; the majority of our genome seems to be symbolic dreck. Most mutations are akin to absentminded mistakes in transcribing grocery lists from weeks ago, long after the desired food was purchased and cooked and processed into so much heat and shit and exhaled carbon dioxide. But some errors are problematic. And because the information in our cells is a copy of a copy of a copy, mistakes aggregate over time, compounded.

The worst mutations are those that make cells forgo suicide. Our good health depends upon some cells resigning themselves to death for the benefit of others. Any cell not part of the germ line is terminal

anyway. Somatic cells can reap no benefit by propagating at the expense of the organism as a whole. But some divide heedlessly. This is cancer. A cell and its progeny and its progeny's progeny flourish, the scaffolding creature dies, the blameworthy cells inevitably also die. So it goes. But no one has documented a lobster's death by cancer. One goal of the Lifespan Initiative is to consider the lobster: is there some way that humans could be modified to resemble lobsters, biochemically, and likewise never die?

The research pursued by our man Dr. Ostentane has less lofty aims. He studies brain-machine interfaces, techniques to lend humans telepathic control over artificial limbs or even entire robotic bodies. Nothing his group works on could ever result in *eternal* longevity. But his success would significantly ameliorate the current indignities of age and disease. That's important, too.

Let's face it: academic research is slow. Other projects in the Lifespan Initiative have long-term aims more bold than those of the Ostentane lab, but *their* successes will be unlikely to benefit anyone alive today. Whereas Dr. Ostentane feels optimistic that *his* work can help in time. He has more to do, obviously, but it's not unreasonable to imagine human applications within ten or twenty years.

At least, it didn't seem unreasonable to imagine those near-future human applications a minute ago.

That was before Dr. Ostentane realized that his grant is all fucked up.

Now he's sitting in his office with his head in his hands. He doesn't even want to look at the travesty on his computer screen. His office is brightly lit. His window is a sleek slab of reflective black. It's ten-thirty, and he has just now realized that when Endnote crashed, several hours and many overwriting saves ago, it must've mangled all the citations for this grant application.

The grant has to be post-marked *tomorrow.*

He's trying to think back. The program crashed around seven o'clock this evening. After restarting, he scrolled through the whole document and it wasn't immediately obvious that anything was out of place. He was mistaken. Everything is jumbled. Experimental details that should be referenced with his own past work have somehow been replaced by papers on simian psychoses. Citations that shouldn't even be in his Endnote library are sprinkled through the document. References to papers that convey essential background information are missing. For a forty-page National Science Foundation grant, he ought to have a few hundred citations. No more than a dozen seem to be correct.

This will be arduous to fix.

And, look. If he doesn't do this right, his grant will not be funded. When the federal budget dried up, they eliminated a lot of funding for scientific research. But Dr. Ostentane *has* to bring in grants. If he doesn't, his students can't do their work. And that is how the world ends. You run out of money and you fade away. A rejected renewal can undermine a whole career's worth of solid work. No way will the NSF give him an extension. There's enough good science being proposed these days that they can afford to triage anything not postmarked by their arbitrary deadlines.

So he'll fix this. But it's very late. He already anticipated having more to do tomorrow to get this document looking perfect before submitting it. Which means Dr. Ostentane might not go home tonight.

Now might be a good moment for him to take a few deep breaths and remember why he does this work. Because, yes, sure, there are the immediate thrills of seeing your name in print. Or giving a good lecture and basking in the applause. Even looking at data alone and realizing that you are on to something big. The rush is great. He can't deny that. But, really, he does this work to help people. There are things the world needs, and he can get them done. He can do this. He *will* do this. Those are thoughts he articulates to himself.

And there's another motivation. Deep down, too primal to state aloud. Which is: Dr. Ostentane does not want to die. And *that* is why he works so hard. Sure, there's the whole idea that by putting out successful papers, work that'll be read and referenced years from now, the world might not forget his name. But that's not all. He is working on technologies that could one day preserve his own life. That could, should his body fail, preserve his own brain inside a machine.

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In addition to the biology department's Lifespan Initiative, there's a competing program at this university run by the computer science department. The Mechanical Mind Initiative. As you'd expect if you've had much experience with neighboring cultures that espouse competing mythologies, most people involved with the MMI have dour things to say about the biology department's efforts.

"Shortened telomeres may well contribute to human aging," wrote Dr. Harold Thorpe in a critical review for *Neuron*, "but even if chromosome caps could be maintained pristinely, life- threatening

mutations in the genetic code would accumulate. No biological polymerase can have perfect fidelity. And with *any* non-zero error rate for an organism's DNA replication machinery, eventual demise is guaranteed." Dr. Thorpe specializes in automata theory and has done research on, yes, you guessed it, self-replicating machines.

It's easy for people to believe that the paths they chose happen coincidentally to be correct. Nobody scoffs at Methodists like a pastor born to Presbyterians. And it's the same for professors in the Initiatives. They belittle their competitors because if either program succeeds the other will surely die.

The main goal of the Mechanical Mind Initiative? They're hoping to preserve an electronic replica of human consciousness. The idea is that, because neurons have only finite connectivity, you could simulate a brain using computers of similarly finite capacity. By mapping the location and potential firing rate of every synapse, then recreating the whole network within an inanimate non-degradeable system, it should be possible to maintain the essence of a human indefinitely.

Of course, we cannot yet predict whether a condition analogous to cancer might beset near-immortal minds. Whether there are certain self-replicating nihilistic thought patterns that might obsess any consciousness blessed with sufficient longevity. Horrors that we, with our terminal lives and concomitant fears and motivations, cannot even imagine.

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As it happens, there is a known treatment that consistently results in lifespan elongation across a wide variety of species. Caloric restriction. Works in mice. Works in flies. Works in worms. Epidemiological data suggest it works in humans too, but nobody's published a controlled study yet. The San Quentin experiment is only two decades in, so their data is still inconclusive.

For insects, caloric restriction is achieved by diluting their food with an inert polymer. They always eat the same volume, even when they can't digest it. For mammals, since they can be stored in isolated cages and fed discrete quantities of pellets, caloric restriction means simply providing less for them to eat.

Between two- and ten-fold extensions of lifespan have been observed. There may be minor issues with mental atrophy. The mice, for instance, spend most of their time unmoving, unblinking, staring at their empty bowls. But results so far suggest that any methodology able to reduce a creature's

metabolic load might extend lifespan. Some groups are even testing alternatives to starvation: lowering the ambient atmosphere's concentration of oxygen, typically by supplanting oxygenated air with sulfurous fumes, also yields appreciable success. Because, well-fed or not, when a creature is deprived of oxygen, its metabolism slows. Fades like a candle in a jar. And, like so much unmelted wax, the creature persists for longer.

Obviously a team associated with the Lifespan Initiative is working to translate these discoveries to medical applications. There are some caveats, of course, which is why this knowledge hasn't supplanted other research. The major issue is that these longevity techniques require serious deviations from a typical human lifestyle. It's hard to stay hungry if you're free to eat. Effective caloric restriction in excarcerated humans might require clamps. That's why the team is focusing their initial translation efforts on the world's most sedentary occupations. Like librarians. Or entire information technologies departments. Or legal work: Supreme Court justices could be preserved a hundred years or more in deoxygenated chambers.

It's air and breath and wakeful wasted thought that'll get you in the end.

Our man Dr. Ostantane surely knows this, at least as well as you or I do. And yet, here he is. Pushing through the night, his metabolism working overtime. Killing himself for his fervid dream to stay alive.

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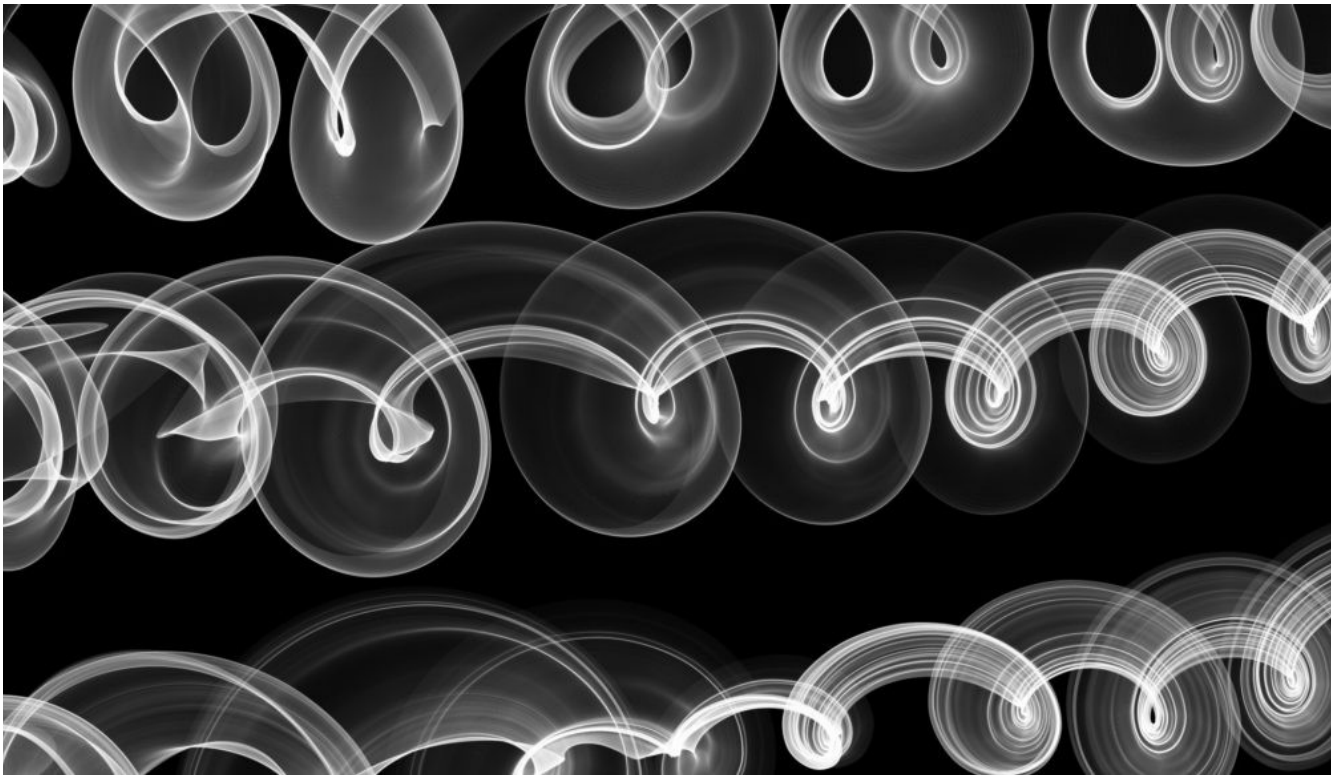

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