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Sorting the Sunlight:
Frankenstein, Nanotechnology, and Literary Vision in the 21st Century

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The image of Prometheus, bound or unbound, informs the two-edged reputation of science. We don't want to know too much; we might do something stupid and be punished eternally. Vultures will daily peck out our liver, which will regenerate every night.

Perhaps this is because while we have the capacity to know, our moral maturity seems lacking. In addition to this, the complexities involved in, for instance, genetic manipulation are so tremendous that it is impossible to know what the ultimate result might be.

Mary Shelley's Frankenstein was an astoundingly prescient novel. She lived at the very crux and pulse of intellectual thought in the seventeenth century. Her mother, Mary Wollenstonecraft, wrote A Vindication of the Rights of Women and her father, William Godwin, An Enquiry Concerning the Nature of Political Justice, both extremely influential treatises. At that time, science was a gentleman's pursuit. It was not difficult to understand or at least know about all of the currents of scientific thought and of speculation concerning where they might lead. Just as now, there was talk about the possibility about creating life, and, just as now, there was heated discussion about whether or not that was the right thing to do. Mary actually knew some of the players. She had privileged information. And she knew a lot about being an outsider.

Mary Shelley herself, though from a privileged background, had a difficult life. She ran away with Percy Shelley, who deserted his pregnant wife, when she was sixteen, and their first child, born soon afterwards, lived only a few weeks. Percy's wife committed suicide a few years later. Though subsequently married to Shelley, Mary was shunned by society; the ways in which she, her husband, and their friends chose to live were definitely outside the norm. She had five pregnancies and only one child survived to adulthood. Her husband drowned when she was twenty-five. Although her father-in-law was extremely wealthy, he refused to support Mary Shelley and his surviving grandchild.

Because the many film versions may have obscured Shelley's story, published in 1818, I will briefly recap: Victor Frankensteinis sent to school, where he is able to live in complete solitude and to indulge in his obsession: the creation of life. He gathers body parts from cadavers, stitches them together (deciding at one point to make his creation taller than most men), and animates his creature via electricity. Vivisecation and galvanization of frogs and corpses were part of the scientific scene when Frankenstein was written.

The creature at once rushes away, and Frankenstein's next hint that he is still alive comes months later, when his little brother is found dead. He intuits that the creature killed his brother, and soon finds that the creature has spent his short life spying on what Mary envisions as a perfect family--altruistic, loving, and non-sexist--and thereby has learned to speak, read, and absorbs important texts in the Western canon. Rejected by that family when they actually see him, keenly aware that his appearance is horrific, he begs Frankenstein to create a mate for him and threatens blackmail--further murders of Frankenstein's loved ones--if he does not. Frankenstein reluctantly agrees to the bargain, but destroys his female creature half-made, realizing that he may be loosing a plague upon the world if they procreate.

Mary Shelley's goal, when nineteen and challenged to write a ghost story, was to "horrify." She succeeded.

Apparently our fears regarding intervening with the life processes have changed very little since then. Outrage, fear, moratoriums on research (both self-imposed by scientists and imposed by governments) are the norm in response to the now very real possibilities of the cloning of humans, the creation of transgenic plants, animals, or humans, and the possibilities of using the information we have about the genome to cure or prevent cystic fibrosis, taysaks disease, and the like.

There is also the ever-present idea that it is impossible to improve on that which is already in place: call it God, or call it Nature; it is the Given with which we ought not tamper; the apple we ought not eat.

I have a happy solution to this conundrum: here we are. Let's do the best we can with what we have.

What we have is our minds. With our minds we have created tools to enable us to see on a very fine level. What we are presently deciphering are not "secrets." No one "hid" them. They have always been there. When we turn this vision on ourselves, we certainly see room for improvement.

It seems to me that, centuries after Frankenstein was written, it is time to consider new approaches to the vistas which our various sciences reveal. It is as if our vision has been flooded with light, and we need to begin to develop the facility to sort this sunlight, to bring it into focus, and to use it in ways that are clearly beneficial. What will our new sciences be, and how will we use them?

Just as there was something repugnant about the monster’s manufacture from body parts gathered from cadavers, there is strong public aversion to adulteration. The expression of genetic certainties might, it is true, take generations to manifest, or might never. There is much that we do not know, and little that we can actually control. But why must what we create, or know, or use, or manipulate, manifest in that which is detrimental? Why is this considered hubristic?

Where does hubris begin? Is it hubris to splint a leg? To remove a ruptured appendix? To give a patient a new kidney? To do heart bypass surgery?

To study ways in which we can circumvent the outcome of cystic fibrosis? To implant a new or artificial heart?

To make our children wiser, smarter, better? Isn't that what humans have always tried to do? Should this quest end? Can it? Frankenstein learned, apparently, that he could only create monsters. He didn't try to refine his model--which is understandable. He was under a lot of stress. But that was because he had to work in darkness.

I remember, in the seventies, the bruhaha over test-tube babies. In vitro babies. There was enormous public outcry---to the extent that when I underwent this process (unsuccessfully) in the mid-eighties, I did not tell the parents at the large Montessori school I owned and taught in what I was doing. For one thing, I lived in a rather conservative city, and for another thing, it was none of their business. If the pregnancy had been successful, I did not want the child to be subjected to scrutiny. With the general success of this method, there are now many such children, and in vitro fertilization seems to be accepted by the public. But it took twenty-five years.

Any process that threatens to change the ways in which we reproduce is generally viewed in a negative light in public discourse. It is the giving of life which is the sacred divide, the enlivenment of matter typically thought of as non-living. The re-animation of dead bodies is a staple of horror movies. But creating a zygote in a petrie dish would seem to be much more palatable. And if there is a gene for longevity, why not attempt to bring as many of us as possible into this realm of the healthy and functional long-lived?

In a recent NYT article, a college sophomore argues with his father, a longevity researcher, about the wisdom of enabling more people to live longer lives. He brings out the old saw of overpopulation and its ills. The one thing he does not take into account is that he himself is young. I can guarantee that, with the wisdom of age, or, at least, with the possibility that he might have more of life when his margin is growing thin, he would abandon his arguments and hold to life as hard as he possibly could.

I went to Virginia Tech in the early nineteen seventies. I took some psychology classes. All of them were about rats, and how they behaved, and what their brains showed after they learned something. A friend of mine had the job of killing the rats. They were useless, they had learned something. Obviously, they couldn't be set free. I suppose that if they had been processed into rat food we could now be afraid of mad rat disease. I can be excused for thinking that science was somewhat horrific.

I know now that a lot of information about how our brains work came out of that research--information that is useful when highly specialized physicians deal with our loved ones

in various capacities. But what price are we willing to pay? That seems to be the question here. Rats? Sure. Dogs? Monkeys? Human embryos?

We are indeed still dealing with these questions, centuries after Shelley. Some of the keys to understanding and in some measure controlling change lie in various domains, chiefly those of education, not only of scientists, but of everyone concerning the world in which we all live.

There are scientific buzzwords having to do with the giving and manipulation of life which sometimes have the effect of striking terror into our hearts. Cloning. Genetic modification. Stem cell research. Genetic engineering.

One of the very latest buzzwords is nanotechnology. It is slowly entering the mainstream through the efforts of the National Science Foundation, which presently has a mandate to educate the public about nanotechnologies. So the big question, at that level, is: what, exactly, is nanotechnology? What ought we tell the public about it? Their own recently produced book is titled Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science. That covers just about everything. And that's kind of what nanotechnology is, right now. There are real applications, and a lot of blue sky, in every one of these fields.

Last week I was invited to a conference at the University of South Carolina. The name of the conference was “Imaging and Imagining NanoScience and Engineering.” Why do we need to image and imagine a new science, a new endeavor of engineering?

Because that science, and any subsequent technology, takes place in a very small realm. "Nano" as a scientific measurement means one-millionth. Things on the nanoscale are sub-microscopic. That is why they must be imaged. To image, one must imagine. We must interpret the data, because these very small events cannot be seen. We only see their results. So we have the paradigmal computer renderings of nanoscale constructions and possibilities---brightly-colored spheres, stuck together. One of the transformational images of the age are the letters IBM, made of xenon molecules manipulated by the scanning tunnelling microscope. This is not exactly an imagined image, but it is interpreted and enhanced with technology.

Another reason is that it must be imaged and imagined is because of its vastness, and for its potential for both positive and negative outcomes. This is where the public dialogue comes in.

Nanotech has the potential to be invasive, to change the body, and even, most radically, the brain---mind and consciousness. The claims for nanotechnology are huge. It may give us very long lives, very cheap and easily reproduced and modified material goods, and make us very smart, and even mentally very different, via the hypertexting of information and its melding into the biological sphere and through easy and precise access to any system in the human body. At this conference one of the remarks I thought important was that we ought to

be speaking of nanotechnologies, rather than simply nanotechnology. The materials, potential, and scope extend into the realms of external and internal, and they extend farther than we can see or predict.

One of the Frankenstinian images offered by Eric Drexler, the first person to systematically examine the possibilities, potential, and downside of nanotechnology in his Engines of Creation is that of "gray goo," in which nanotechnological agents replicate uncontrollably, turning everyone and everything into just one thing. Greg Bear, in Blood Music, portrayed a future in which a biological agent gets loose and transforms all consciousness into a noosphere in which individuality is lost; it is regarded by many as the first nanotech novel.

Biological manipulation and the potential for the creation of life took a back seat, mid-century, to nuclear physics--which gave us the very same image, that of a deadly and uncontrollable reaction which might transform all matter. But scientists interested in the creation of life have been working for a century to reach the place where we now find ourselves. Aldous Huxley, in his 1932 novel Brave New World, in which children grown outside of the womb are designated as alpha, beta, or gamma, according to the needs of society, was one of the most striking science fictional thinkers in that area. That was a long time ago, and his novel is satirical. It all seems to boil down to this: We do not want to do without mothers. Any attempt in this direction would be disastrous. Frankenstein's being had no mother--and no present father--and that was one of his chief complaints, and led to all of the destruction he wrought.

I think that we, collectively, don't know much about the sciences, and that is one of the problems. Many children don't even learn how to read, so I suppose that it is optimistic of me to call for a lot more than that. I think that learning about the history of science and technology and the philosophy of science and technology could serve to excite children about the possibilities of science. The idea of competent scientists teaching children their subjects is unlikely to be executed soon--those specialists are reserved for graduate students. And the convergence of teaching ability with a gifted understanding of a subject is rare.

I suggest that we genetically engineer these folk.

I suppose that would be somewhat cruel. They would have no free will. So it is a mutually exclusive proposition. I believe that intellectual curiosity and free will are inextricably twined.

Maybe it's not a good idea.

Our next best idea might be to look at the myths deconstructed in science fiction, and in the various futures portrayed therein. Reading science fiction is to fan out a deck of cards. Infinite games, infinite possibilities, are contained therein. Just as in any genre, including the genre of literary fiction, there are good and bad examples. It might serve us well, though, if the general stigma against reading science fiction--and there is a stigma; just observe Margaret Atwood's frantic distancing of her new novel from being labeled as such--were to abate, to

have this literature as widely read and discussed by reading circles as are the most popular works of fiction, many of which come complete with a list of questions in the back. One of the questions in any sf book might be: is this possible? Why or why not? Is this possibility good or bad? Why?

Science fiction--and it is the theory of many that Frankenstein was the first work of science fiction ever written--is uniquely situated to think about these issues from a human point of view rather than that of pure information. If it is possible, will we ever have parks of genetically engineered dinosaurs? Or human clones? Why not? I would not be too surprised if human clones are alive in the world right now. One of the things which we ascribe, incorrectly, to clones, is an emotional constellation. This seems somehow horrific to most people, who think immediately of a lot of Hitlers. Actually, a lot of anyones would probably be unpleasant, but at the same time, terrifically unlikely simply because no environment is repeatable. If you had three clones in one family spaced in two-year intervals, each would experience a different family and a different childhood. But the real problem with clones, in my opinion, is their physiological sameness, their vulnerabilities to the same diseases. At least now our problems are spread out over a spectrum--heart disease, stroke, kidney malfunction, arthtritis, and so on. We can all complain about different problems. If we were all clones, it is conceivable that one virus to which we were all vulnerable would soon make short work of us. Sexual reproduction, which all living creatures do not practice, leads to robust variety. That is why it evolved. So if we think hard about clones, we might be inclined not to go in that direction in a big way. As for Jurassic Park, the idea is a lot like the song "My mommy said not to put beans in my ears." I think it will be here very soon, but hopefully a Disneyfied version, like the little Key West they have created in Epcot.

There are mental and emotional barriers against change. We have spent, literally, ages, trying to come to terms with our own mortality. We have developed elaborate visions of an afterlife, of which cyberspace is but a thinly veiled copy, where we might be immortal and limitless in terms of what we might conceive and what we might do. This long investment could account for negative attitudes toward bodily improvement and enhancements. The known-- i.e., death and a possible heaven--is much more attractive than the unknown, i.e., where are all these old people going to live, and who will pay for them, and what will they do? Continue to meddle in the lives of their children? Obviously, new models of family and of society would evolve, and that is scary for some people, and it ought to be at least thought-provoking to those of us who are not afraid.

Consider that in forty years we have gone from the paradigm of "the unwed mother" to the empowerment of women able to choose to take care of their reproductive choices without condemnation--or at least without secrecy and shunning. There are practical and social and economical reasons why it might be better to raise a child with a partner. There are also reasons, including adults who have no idea of how to raise a child and adults who simply do not want to, that it is good for children that there are alternatives.

The big question of early work in molecular biology was: Can humans be modified? We now know the answer. The answer is yes. We are already modified, with drugs, birth control pills, the possibility of in vitro fertilization, extremely specialized surgeries. The questions now are, how much, how fast, and most importantly, why. New brains for old? How lovely that would be. I would like an approximation of my nineteen-year old brain--its speed of calculation, the way it made connections, its sheer optimism and sense of being unlimited and able to solve or create anything of its choosing—without all the havoc that lack of emotional experience can create. I am sure that at some point, Einstein wanted his younger brain back again. I would like enhancement of senses, a deeper appreciation of art, music, and literature. I would like a mathematical mind. I would like a pain-free, thin, healthy body. I would like choices. I would like a permanent sense of appreciation of life which would not wane or be damaged. I am sure that this priority list would vary with every individual, who would have to know, as we now know about the drugs we are prescribed, what the benefits are, and the hazards.

When we study our fellow travelers on earth, we find astounding things. For instance, research on rainbow trout revealed, a few years ago, the process by which birds, fish, whales and turtles migrate via cells sensitive to magnetic stimuli. What if we could experience this deep orientation? I use this idea, magnified and changed in various ways, in Light Music.

But must science follow its every curiosity, as we did, in secret, with the atomic bomb? Probably much of the current negativity about "science" has to do with the fact that the possibility of complete annihilation appeared seemingly out of nowhere, dominated politics and even everyday life for decades, and still poses a threat. Might it be best to just not go there? The discovery of nuclear fission was pressed into service by the United States because European physicists believed that the Nazis were developing an atomic bomb, and it was used to show that we had it. It is probable that many or most of our future advances in science will be mostly due to products and processes developed for war.

Our everpresent enemies, though, are starvation, disease, disability, pain, impairment of human function, and ourselves--the territorialism which makes us go to war rather than negotiate, and to feel rather glorious about the decision. Biotechnology advances against an enemy which threatens to take our loved ones from us with an inevitability stronger than any pernicious political system.

Our very consciousness is based upon the fact that we are composed of biological programs which combined eons ago because of some benefit or some way in which one could be exploited by another and the exploitee would still exist. It is hard to get around this fact. Spirit and consciousness and all that we have so passionately ascribed to a realm other than bodily are, in fact, of the body. There is no other world. To me this is not depressing. It is exhilarating.

Biotechnology is much more subtle than the methods Frankenstein used. All of us are products of biotechnology. I don't think that any of us here has not benefitted from

antibiotics, surgery, drugs, and vaccines. The problem is, once we can be more invasive, and more altering, how can we choose what to do--for ourselves, for others. What methods ought we use in deciding what level of exploitation we are comfortable with? How can we predict what the results might be?

As a former Montessori teacher, I will forever remain fascinated by the way that we as a species unfold in response to our environment, cued by an almost unfathomably complex series of biochemical events. Children are exceedingly plastic. Although personality seems embedded within them, it is easy to implant ideologies, as well, and action springs from what we believe to be right and wrong. Frankenstein's monster--or, as Percy Shelley calls him in the forward to the book, Frankenstein's Being, capital B, undergoes the process of childhood in an admirably compressed manner, by eavesdropping on the perfect family. But even people with the highest ideals, whose actions spring from altruism, are repulsed by the appearance of the Being. People react to his wholly manufactured appearance, and reject him; they reject the face of Science, of artificiality, of an attempt to play god, and thus bring out all that is bad in human nature, with which the Being has been invested.

We do not understand what is happening. We know part of what is happening. We can make rats fat or thin, make them live long or short lives, make them smart or make them dull according to our own definition of such. Yes, we are playing with other creatures. Yes, we are extracting a part of their genome and combining it with the genomes of other creatures. But nature--and I submit that we are obviously, by definition, Nature as much as anything else--is much more fluid and opportunistic than we, with our time-narrowed point of view, can possibly appreciate.

Manipulating ourselves and other creatures is nothing that has not happened before with our intervention. We have bred animals and plants for millennium. We choose our mates by their appearance, consciously or unconsciously. Perhaps because of the slowness of our methods, these have not seemed like drastic processes.

Like all literature, Frankenstein was written, and was read, in a particular intellectual climate. What is the moral? That humans cannot possibly create a beautiful cyborg? I heard it said last week that Frankenstein was not a bad person--he was just a bad scientist. He turned away from the world, a precursor to that pervasive stereotype of the "mad scientist," to nurture his own creation--which is really not unlike the effort of any writer or artist to concentrate on their own creation. Perhaps the lesson is that science becomes so enamored of what it can possibly do that it ignores what might come of its efforts. The problem is this: science, and knowledge in general, advances in unrelated snippets here and there. In the past few years, and in particular when it comes to nanotechnological research, the call has gone up to interdisciplinize science, to get the sciences talking to one another. But they do not share a common specialized language, nor do the sciences even look upon an object with the same sort of vision. A physicist sees a different cell than a biologist sees.

I have found that some of the most avid readers of science fiction are acamadicians. My next speaking engagement is at the University of Idaho, where I will address physicists. Drexler is a fan of my work, a fact that amazes me. Perhaps science fiction is a sort of unitive force for scientific disciplines characterized and splintered by details. Science fiction tries to see the big picture.

Must all our efforts to better life fail, as did Frankenstein's? Of course not. We seem to be saddled with the image of Prometheus, endlessly tortured for stealing fire from the gods. Instead, I offer a new paradigm: that of the sun, the radiative energy that gives and sustains life.

In my latest novel, LIGHT MUSIC, I look at the fact that we live in the midst of a vibrational field, and that our senses have evolved to collect and interpret these frequencies. Much of our brains are dedicated to the visual, but our ears register sound, and somehow our brain coordinates this information and gives us a sense of harmony, of time. What, I postulate, might happen to our identity if we became capable of sensing other frequencies--for instance, bees see different wavelengths than we do. I try to put a very positive spin on this, and it is a process which takes a hundred years and then--much like what happens when children begin to talk--suddenly, the process has been integrated, and we grow and change. This is only one thread of a complex narrative, but it is integral, and it is the kind of vision that only science fiction is capable of examining. There is no other form of literature which looks not just at who we are but what we might become. It is a way of thinking about our future and, at this particular juncture, it seems an important thing to do. Not didactically, and not in fear, but in a spirit of promoting understanding about what science and its practical handchild technology can do for us and against us. Who can say that the telephone is bad? Who can say that the computer is bad? Let's move into the realm of our own bodies, into the invasive realm: who can say that the polio vaccine is bad? Who can say that we ought not try our very best to cure cystic fibrosis?

There are many who believe that research using animals and/or humans is wrong. Scientific and technological ethics are absolutely necessary. Happily, we live in an age in which there is a certain transparency. Any of us can read source articles and papers in scientific journals and if we cannot interpret them at first, we can learn the language and make more sense of them. We can talk to those who do understand. We can bring about a dialogue.

Science fiction is well-equipped to do this.

We now have better and better tools with which to see that which actually surrounds us, and to see what we are made of and how we function. We are purely products of what works. There is no reason why we cannot improve on this, to think about what our goals might be regarding science and technology. We have the power to sort the sunlight according to what we deem is right and good through thoughtful consideration, dialogue, and what might be the most important characteristics of our species--intelligence, generosity, altruism, humor, love, and hope.

Science fiction is the literature of change. Paradoxically, it is the only literature that sees the world as it is now, not as it used to be. The potential for billing disputes aside, what present-day teenager would not welcome the implantation of a cellphone-like device within their body, perhaps even with quasi-telepathic properties much like E.O. Wilson's DNA based mode of communication in his scientific treatise Consilience, which he calls mindscript. We are all about communication right now. We are certainly not all about the joys of solitude and the fruits thereof. Even the most dedicated writer has succumbed to the invasiveness and constant presence of the Internet, because it is also useful.

The texts of the real and of the possible are the stuff of present science fiction concerned with nanotechnology. But there is a divide here. Apparently the NSF was dismayed that the movie of Prey is soon coming out. It is, like all of Chrightons books, a science horror story. A distributed consciousness, nanotech run amok, tries to "take over the world." The implication and the fear is that our product will be radically different than ourselves and will not share our values or our goals. But must that be so?

In QUEEN CITY JAZZ, what happens to Cincinnnati, by that time a post-nanotech (and, in Vingean terms, a post-singulrity) Flower City, is indeed disturbing. One person's vision of the American arts envelops an entire population, which relives the lives of jazz muscians, novelists, characters from American literature, and visual art endlessly and without volition. I took my dream and made it their nightmare. The problem, again, is that of free will. And it comes about because of the ease with which, possibly, a radical functioning nanotechnology will be able to manipulate the stuff of mind. MISSISSIPPI BLUES, which follows QCJ, is a book about our relationship with that which has been created. It is about identity, free will, choice, and about deep Americana in the form of Mark Twain and his own problems with identity, truth, and vision, and about the divide between the ideals and the realities of the history of the United States.

In CRESCENZT CITY RHAPSODY, I envisioned how this future might have come about, through the believable bungling of governments devoted to secrecy and to exploiting science not for the prosperity and evolution of humans and of the planet at large, but for profit and for defense. In this near-future world, events move quickly toward the singularity, and the work of one individual, Marie Laveau, is instrumental in establishing a refuge, a place of scientific transparancy, a floating apolitical Crescent City. And in LIGHT MUSIC, the concluding volume of the quartet, a form of human transcendence occurs, with the help of thoughts from science writers such as Eric Green and his beautiful explication of superstring theory, The Elegant Universe.

I am an artist, not a scientist. My sources are books about science written by scientists, Nature, Science, Science News. I assemble a possible vision of the present and of the future by taking into account things that are happening right now.

Because nanotechnology is a fuzzy term, and because it encompasses many disciplines, including chemistry, physics, and biology, it will continue to be a fruitful mode of science fictional inquiry into where our sciences and our technologies may take us both in the near and the far future. Despite the necessity of darkness for the sake of drama, science fiction is essentially a positive and hopeful literature which, by examining both the positive and negative potential in our world and in the information we are revealing and beginning to learn how to use, contains strong, socially useful narratives which can help us navigate the rapids we have already entered. I told Eric Drexler a few years ago that when finished with my nanotech quartet, I wanted to turn my mind to a different future. My problem was that I could no longer envision a future in which nanotechnology is not an important and powerful facet. He said, "I know what you mean."

I'd like to end with a quote from Buckminister Fuller, which I used in QCJ:

"This is harnessed--not worshipped materialism--true mind over matter--on the road from the complete, stony, compressive darkness of selfish materialism to the infinity of lightful, astract, harmonic unselfishness."

This is what we ought to be doing--sorting the sunlight revealed to us through our own efforts, and using it for the benefit of all.

And finding out what that might be.

Thank you.