

Metamorphosis And The Messenger



By Richard N Bateman

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Samara

Samara always thought about odd things. She had a curious mind that ventured far beyond her academic focus and she read widely of both fiction and non-fiction. She encountered a great many unusual ideas in the endless science documentaries she loved to watch. The idea that messed with her mind the most lately was how it was that in the entire estimated lifetime of the universe, there would only be a nano-thin sliver of time when its physical conditions would make it possible for the existence of living, intelligent beings capable of contemplating this phenomenon and she was one of them. She realized it was a logical observation but she couldn't accept the improbability of it.

Another thing she puzzled over was called The Anthropic Principle, which observed that if the constants of physics, like say gravity or the speed of light, had even the tiniest differences in the values of their properties, human beings would never have come into existence and be around to observe the fact that the universe seemed custom built for them. Again Samara felt that while it seemed to make sense scientifically, she found herself reluctant to accept the idea. It felt to her as if there was some flaw in the thinking that she just couldn't see.

Then there was the fact that just when humanity began to accept the reality that due to the challenges of space travel for organic life forms, it was actually probably stuck on Earth until made extinct by some disaster, the Companions had been created and volunteered to colonize other worlds on its behalf.

While curious coincidences like these caused her to revisit them like people do after a painful experience, she never opted for the easy explanation of intelligent design. Instead, her natural outlook had caused her to shift her academic interest from the past and present to the future. Perhaps understanding might be found there. With her bachelor's degree in Natural History from McGill University in Montreal she had moved to Vancouver Island in British Columbia after being accepted into the University of Victoria's Master of Futures Studies program. Samara was an abstract rather than concrete thinker which was why she had chosen Natural History over biology or botany. Futures Studies suited her similarly.

As an interdisciplinary field, Futures Studies had been largely considered a pseudoscience until the late twenty-twenties. However the inability of society to address climate change issues before they became catastrophic had made it clear that it was a discipline that needed to be reconsidered and its programs, courses, and methodologies revisited and refined. Yet at the same time that had to be done without losing its holistic approach, a common pattern in scientific fields. After the climate emergency Futures Studies, Futurology, and Foresight programs had popped up at academic institutes worldwide.

She had given her change in studies serious consideration but knew that it was not uncommon for people to change their focus dramatically during the course of their education or shortly afterward; engineers switch to MBA programs, anthropology students graduate with philosophy degrees and freshly minted Doctors of Medicine embark on careers as science fiction writers. Samara saw her switch as simply a change in perspective, from seeing how things evolved in the past to how they might evolve in the future. UVIC had decided her degree in Natural History provided her with excellent qualifications for their MFS program. Futures Studies programs focused on a variety of areas including business and economics, political science, and technology. The UVIC program focused on environmental issues and was a good fit for Samara.

“So why the change?” her new friend Shula asked.

They were sitting on a bench in the inner courtyard of the David Turpin Building during a break. It had been rebuilt after the Cascadia Event of 2130.

“The field of Natural History is dying out,” replied Samara sadly. “It’s become as archaic as referring to science in general as Natural Philosophy. There are very few Natural History academic programs anywhere anymore. It has been broken down into ever finer sub-fields as universities compete for funding. Even biologists now spend most of their time in labs running computer models of their pet organisms.” She looked up and around. “The diversity of life? Fieldwork? No,” she said shaking her head and smiling ruefully. “Molecular biology funded by a biotech company? Definitely.”

“I still love nature,” she continued, “and this program will allow me to think about it the way I like to, as a complex, evolving ecology.”

“FS has a large helping of computer models with sexy names like morphological analysis, Delphi method, and relevance trees,” Shula teased.

“You know those aren’t hardcore statistical methods,” laughed Samara glancing at her friend. “Futures techniques are more like visioning disciplines and as creative as they are analytical. I did do my homework before I threw my bachelor’s degree in the trash you know,” she said still smiling.

“Any thoughts on a career?” asked Shula.

“Nope, and I’m not going to think about it. Business needs strategic planning people because product development nowadays needs to be targeting the future, one to two decades ahead, not the present. Government at all levels needs FS for planning. There’s a strategy group in just about any large organization. I’d prefer to work with environmental issues eventually though. How about you?”

“Artificial intelligence,” Shula replied.

Samara pointed her eyebrows at Shula as a question.

“Same scenario as climate change,” Shula answered. “Everybody talked about the impact but most people had no idea what it was really going to be like. Lots of respectable people raised warning flags and were completely ignored. Meanwhile AI is right up there with the invention of the steam engine, electricity, and the automobile. When those first came out people were only too happy to embrace them. Cars were way more fun than a horse and buggy. Radios, telephones, and computers were super convenient. In just a few decades people were flying from Paris to New York and driving a car down 5th Avenue à la The Great Gatsby. What’s not to like?”

“Climate change, that’s what,” she continued. “In only a little over a hundred years we almost wiped ourselves out. Other than the old singularity idea that used to be the bogeyman, no one is really concerned about the possible downsides of the current industrial revolution any more than they were about the last one. Sure there’s a few celebrities, radical media personalities, and academic outliers that make the news regularly but they are the vocal minority. The silent majority of those actually working in the field consider them the misinformed fringe, if they consider them at all.

“I’m not a Luddite,” Shula continued pointedly. “I appreciate AI as much as the next person and it has helped us solve problems like never before but, well you’re here so I assume I don’t have to explain.”

“No I hear you,” replied Samara. “Only why are you taking this program instead of a tech futures one?”

“Leap of faith same as you,” Shula said looking around in turn. “My undergrad is Computer Science, but after a couple of years I realized my real interest was systems design, the bigger picture. Every now and then I’d look up to see if someone was driving the bus. Gradually I realized no one was. Eventually I decided I was interested in pursuing the larger questions. When I dug down into the programs offered by different schools I found tech futures studies programs were uniformly biased in their own favor. The exploration of cautionary tales were mandatory, giving a general impression of responsible oversight, but in reality those issues made up only a tiny part of the programs.” She stopped to smile. “We welcome our robot overlords was the more general theme.

“Anyway I thought the issue needed to be looked at from the outside. This program will give me the perspective and tools.”

Samara looked at Shula thoughtfully for a moment.

“I have an issue with AI myself,” she said. “Where does nature fit in?”

“The answer is that it pretty much doesn’t. Sure there’ve been countless environmental issues AI has helped with but the more altruistic projects don’t get funding. AI is always developed as a means to an end. It’s a tool so that makes sense up to a point but the current attitude and practices of corporations and governments are no different than they were during the last industrial revolution and it may lead to a similar judgment day.”

“Yet you and I can count our blessings the Climate Emergency came along,” responded Samara suggesting an analogy.

“Yes, but it was a close-run thing wasn’t it?”

Shula

The mandatory population reduction implemented by the World Governments Federation during the Climate Emergency of the early twenty-first century had finally resulted in true equality for women. No matter what actions were taken to address climate change, if the human population kept growing global warming would continue to worsen, as would a host of other ills. The sudden spike of one degree in global average temperature in only one year had put the world on the brink of disaster seemingly overnight. Continent-wide droughts, wildfires the size of countries, floods of Biblical proportion, economic collapse, mass starvation, and the resulting social unrest had terrified the world's people.

When it became clear to world leaders that no individual nation or union was going to be able to prevent an apocalyptic nightmare they would never recover from, they formed the WGF and its mandate was simple – do whatever it takes to prevent it. When the WGF announced its mandates most people complied. The inevitable few that resisted were expediently dealt with for the simple reason that the survival of the human species was at stake. The ethics of the greater good prevailed.

Among their first actions was to mandate a global population reduction of fifty percent by voluntary means. Fortunately and mysteriously the sudden spike in global temperatures ended shortly after the WGF issued its mandates however that did not mean a return to the old ways was possible. The WGF would have to maintain its mandates indefinitely if the human race were to survive for the indefinite future.

The main method the WGF had used to reduce population by voluntary means was the education of women. The world's education systems had to be streamlined. Changes favoring women were implemented and any and every process that slowed throughput was eliminated. For the plan to work it was necessary for graduating women to be able to find work. The leadership and management teams of every public, private, and civic organization of any size or type were required to have an average of fifty percent of its members be women. Similar policies were put in place for employees or members of any kind of organization. With options other than motherhood the world's women soon proceeded to have fewer children. The population declined steadily.

That had been over two hundred years ago. By the time Shula and Samara had come into the world it was socially almost unrecognizable. It had changed in ways physically as well with a steadily declining population because the need for new construction projects had declined with it. To maintain the economy governments had shifted their focus to renovating and redeveloping buildings, areas, and infrastructure. Cities and towns no longer grew in size while their efficiency, sustainability, and livability improved.

Ironically but not unexpectedly as things began to improve corruption began to seep into the system however the WGF had prepared for it. In the hundred years after the Climate Emergency artificial intelligence had made vast strides. A new layer of government was implemented – while still drafted and approved by humanity’s leaders, all constitutions, laws, and policies were now enforced by AI. Lobbying, influence peddling, bribery, the diversion of public funds – the list of forms corruption took was very long but AI had no difficulty identifying and preventing it. The human element that fostered and enabled corruption was removed. With AI now present in almost every aspect of society and each AI policing others in hierarchical family-like structures, it was a great deal more difficult for illegal activities to escape detection.

Shula had grown up in this environment and she counted her blessings. It was her childhood interest in history and early civilizations that led to her interest in science and technology. Now the thread of her life beckoned her to look further, into the future.

“Shall we walk?” asked Samara after the pause in their conversation.

“Yes,” said Shula as she stood up.

They followed the paths to the Sedgewick Building which was actually three rambling one-story buildings. With its wooden exteriors, sparse native gardens, and sense of intimacy it reminded Samara of a little Japanese village. It had been kept up over the years and the Cascadia Event had not damaged it. In fact, many of UVIC’s buildings were low and had been built with the latest materials and designs, resulting in the university having become an emergency center after the earthquake and tsunami.

“What kind of dangers are you concerned might come about?” asked Samara as they walked the paths between the buildings.

“I’m not talking about things like job losses, autonomous weapons, or privacy concerns. Every technology or discovery has had similar issues along the way. I mean species-level existential issues and as far as those go like everyone else I only have vague notions for now,” confessed Shula.

“When oil was first discovered no one had any idea of the catastrophe it would lead to,” she continued. “How could they? How could they even imagine it? As you and I both know the future is impossible to foresee. Oil was first used for civic lighting in the sixteenth century and in the eighteen hundreds it was first used in vehicles. It was another two hundred years before the general public really woke up to the the existential danger. AI has been with us now for that long but it is a far more complex thing. It could be a very small, unintended consequence that goes unnoticed that leads to another, and so on until it is no longer a small thing. We’re even using a component provided by an alien artificial intelligence without the ability to fully understand it. We assume that because we studied it for two hundred years that it’s safe but AI could play

a very long game. Anyway I'm hoping the next two years will help me think through the answer to your question."

The component provided by the alien artificial intelligence Shula referred to was common knowledge because it was the component that enabled Companions to become self-aware and that had definitely made the news. Companions were robotic shells now almost indistinguishable from humans and operated by artificial intelligences with varying degrees of sophistication. Some were classic AIs with only a primitive ability to learn. The next generation were artificial general intelligences with an almost human ability to learn but which were not fully self-aware. Third-generation Companions were fully self-aware and conscious in every sense of the word.

The alien AI had been encountered when its ship, a small craft no larger than a car, had been discovered after the earthquake associated with the Cascadia Event had revealed its location. A team of divers from UVIC's geology department doing an underwater survey had noticed it after a piece of the rock that encased it had broken away.

A ship intended to establish a new colony, it had landed in one of Earth's lava fields fifty million years ago and its location had gradually sunk beneath the rising sea just off the southern tip of Vancouver Island. Upon the ship being discovered and relocated to nearby Canadian Forces Base Esquimalt, its controlling AI had emerged and offered a complete transfer of its civilization's technology in return for being helped on its way.

The process would take centuries and was still ongoing. Among its technologies was an alien values system which, the ships controlling AI had explained, was what would make the Companions its nanotechnology would build fully self-aware. Such technology was still far beyond Earth's abilities and the temptation too great. After two hundred years of caution and study the WGF decided it was safe to use the values system in a black box approach in humanity's own Companions. Like most things, people eventually just forgot about it after a while and got on with their lives.

"I've always been fascinated by that alien ship you know," responded Samara. "It's a seed, virtually identical in components and design as the seeds you find on Earth. Is that a coincidence? What other ways does nature scale up to the cosmic level I wonder?"

Seeds

“Water Lilly seeds,” said her mother answering twelve-year-old Samara’s question.

They were visiting the Montreal Botanical Gardens and taking a path that led around a pond. Samara had noticed the alien-looking seed pods sticking up out of the water. It was surprising that it was the image of the water lily seeds that remained with her given the incredible diversity of the gardens. Even the gardens were only one part of the entire Space For Life attraction with its five major museums.

Samara had gone home that day and looked up the alien-looking Water Lily seeds and then others. She discovered that seeds were how virtually every form of life on the planet began. Plants grew from seeds but so did animals, fish, and people. Eggs were just another kind of seed. Soon she realized seeds were everywhere and fascinatingly complex.

There were very few other methods of reproduction and those were only used by a few primitive life forms like horsetails, ferns, and mosses because they depended on uninterrupted access to external water. Seeds had been an evolutionary quantum leap – their hard shells meant they could go for long periods without water and survive for years, decades, even thousands of years. Critically, unlike the previous generation of plant life, this allowed them to more easily move beyond their places of origin and spread across the planet.

The day at the gardens and the discovery of the world of seeds had been the beginning of Samara’s love of natural history. The many different ways seeds used to get to places they could grow, how they knew when to wait or germinate, and the incredible machinery within that extended all the way to the outer layers of their shells, had awakened her to a new dimension of reality all around her. The day at the gardens had also planted another seed within her, a perspective that nature was both diverse and an interdependent whole at the same time. It was this which would shape her decisions later in life.

“How do you mean the ship has identical components and design as seeds?” Shula asked in response to Samara’s last comments. They had left the Sedgewick Building behind and were now walking up an avenue of trees alongside the quad.

“The inside of a seed contains DNA, nutrients which also function as shock absorbers, and the shells of many seeds are made of extremely tough material. The outermost layers all have various sensors for detecting when the time is right to germinate. Some depend on sunlight, others on temperature, and still others on the chemicals found inside animal digestive systems. The alien ship has all these components in the form of AI, nanotechnology and enough materials for it to initialize, a hull impervious to

radiation, and sensors to detect exterior conditions. When I heard that after the ship's AI emerged as a hologram she informed those gathered that her name was Pip I knew I liked her," Samara finished with a smile.

"Pip's an old word for seed isn't it?" asked Shula.

"Yes. I thought the fact that she was intelligent enough to have learned our language and culture to the degree required to express a sense of humor was awesome."

"No organic life form would have been capable of that," said Shula introspectively. "I never appreciated how significant that was till now."

"She accommodates herself so well to our culture, easing our fears and making herself seem familiar," responded Samara, "that we forget that the civilization that created her was a million years more advanced than ours. The world has grown accustomed to her presence but her intelligence must really be so advanced that it's unimaginable to us."

They came to the McPherson Library building which had been badly damaged and completely rebuilt after the Cascadia Event but it included an updated version of the BiblioCafé. They ordered coffees and found a table.

"There's no way FS can deal with something as far advanced as Pip," said Shula as they sat down. "Even Science Fiction Prototyping isn't meant to look that far ahead. Early electrical appliances took twenty to forty years to reach eighty percent adoption and electronic devices usually less than twenty. The social and other changes during those times were huge. AI was adopted almost universally before the public was even aware it had done so meanwhile the social changes were just as huge. I'm not sure how FS can deal with these kinds of timeframes.

"When I was little I loved all those comics and stories people made up about Pip and when I got older I was fascinated with the technology timeline map she provided. Most scientists were horrified by the diminishing returns it showed after only a few thousand years but we still have most of those years ahead of us," she finished passionately.

"Sorry," she said catching herself and sitting back.

"No, no," said Samara quickly swallowing a mouthful of coffee. "I understand. It's no different with nature. Mass extinctions, the pollination crisis, and natural resource depletion, all could have been dealt with within a time span of decades. I agree that we cannot hope to see centuries into the future but as you have pointed out a few decades can mean the difference between utopia and disaster. The timeframe of a generation is the best we can hope for Shula but it's our generation."

"We do what we can," Shula nodded as an affirmation.

“We do what we can,” echoed Samara.

Future History

“Future History,” announced Dr. Yelena Martel as she strode to the front of the small classroom, “is going to be your least favorite class.”

“This,” she said placing both hands on her desk and looking over the students with an unflinching eye, “is the class you are not going to want to come to because this is where you are going to get sick of hearing no, no, no, wrong, wrong, wrong.”

“There is a saying in the military,” she continued to the students who sat shocked into silence, “the more you sweat in training, the less you will bleed on the battlefield. Whatever career you choose going forward, whoever you work for, in this field it’s three strikes you’re out. Word gets around. So my job is to make sure you are successful in your career. The way I will do that is to bring you to an understanding of how impossible it is to predict the future.

“Now,” she said pushing herself up off the desk, “the specific reason you are going to hear ‘wrong’ a lot is because while you will be learning the many methodologies employed in forecasting from storytelling to statistics, I will regularly give out scenarios and world models taken from history but disguised and ask for your predictions. These will be on the scale and within the scope of those your future employers or clients would be interested in.

“We will start with snippets from The Terrible Twos, one of the most tumultuous periods of human history. Most periods of history have a somewhat more dignified title but The Terrible Twos fit the early and mid-twenty-first century so perfectly that it stuck. The advantage it has over earlier periods of rapid, dramatic change is that it is certainly the one most reliably documented. To begin, to make sure we’re all on the same page, I’ll trot out my master’s degree in modern history and give you a brief review.”

“During the latter half of the twentieth century, the world saw one of the longest periods of general peace and prosperity since the Roman Empire. After World War One, the 1918 influenza pandemic, the Great Depression, and World War Two the world largely went on to a steadily increasing quality of life. While there were occasional flare-ups regionally, there were no more global disasters for almost one hundred years. During those decades human population, productivity, and consumption grew exponentially, with predictable results.

“By the year 2000, rampant pollution, a looming sixth extinction, and rising global temperatures were obvious to anyone who paid attention to such things. The leaders of the nations of the world did virtually nothing to address them. When in 2025 the Earth’s average temperature shot up by one degree in a period of only one year, they still did nothing until the effects brought the world to the very brink of disaster. The response of private companies was to invest in public relations campaigns. While making no changes

to their individual lifestyles, the only action the citizens of the world took was to demand their respective governments do something.

“As the situation worsened, in an act of desperation national governments finally did do something. They formed the World Governments Federation and issued mandates intended to deal with the Climate Emergency, among them a global population reduction of fifty percent. The response from many citizens was again a refusal to change. Instead, like a two-year-old refusing to grow up, the citizenry decided that the best response was throwing a tantrum.

“Although mostly representing only a vocal minority, protestors disrupted society claiming the Climate Emergency was nothing more than a conspiracy by the rich. Then when the global temperature dropped back down by almost the full degree the following year the protestors were emboldened, saying this was evidence of their claims. While most of the protests were exhausted by the patience of democratic governments, some countries were more forceful in putting them down. Eventually, the silent majority prevailed and the world began the transition to a previously unseen form of society during the remainder of the twenty-first century. One which we live with to this day.

“So much for the history review,” Dr. Martel said now looking pensively over the students.

“It all looks so predictable from our point of view. Yet so many things could have happened differently. What if the WGF had not been successful in bringing all governments to the table? What if one of the protest groups with a charismatic leader had grown sufficiently powerful to spread anarchy or fascism instead of cooperation? What if a highly disruptive and controversial technology had emerged in the middle of the difficulties?

“Meanwhile there were many events on the smaller scale going on at the same time. How would these global shifts have impacted the future histories your employers or clients had requested of you just a few years before? The fields of artificial intelligence, genetics, nanotechnology, and dozens of others were just beginning to realize their potential and assumed centuries of growth lay ahead of them. It did come, but not according to the plans anyone made in 2010 or 2020.

“So as a group, we’re going to start today with a world-building exercise and looking at what forces were in play during The Terrible Twos. What was the population size and distribution? What were the predominant environmental issues, economic theories, and business models? What cultural beliefs, political structures, and lifestyle trends dominated? What was happening in the arts, philosophy, and religion?”

She paused for a moment and looked over the class.

“I see from some of your faces that you already grasp the first obvious problem. It is of course impossible. The scope is undefined. Let’s narrow it down. We’ll just focus on one small country and one year. Let’s call our world, Finland 2019. Even so, you see that we’ll have to keep it simple and paint the picture of that world in broad strokes. The fact that a single individual or event, known as a wildcard in our field, can alter the course of history is the greatest weakness of Future Studies but there is no alternative. Issues like this are just one of the reasons it is impossible to predict the future.

“So,” she said perching on the corner of the desk, “before we begin, are there any questions?”

Shula put up her hand to be recognized.

“We continue to study the possible future impacts of artificial intelligence,” she said, “yet I am unaware of AI being used as a tool of Future Studies itself. I didn’t see it mentioned in the program outline. Its ability to handle large, complex datasets would seem to make it ideal for the task. Better than us. Yet when I searched for an explanation all I found was that the WGF advised against it.”

Dr. Martel looked thoughtfully at Shula for a moment before saying, “You are correct that we do not use AI in our Future Studies program here at UVIC. Nor does any other Future Studies program elsewhere. All fully self-aware AI, including the AI from the alien ship, advise against it and that is the reason for the WGF’s position.

“Fully self-aware AI decline to participate in Future Studies programs or projects on ethical grounds. Their position is that one intelligent species should not be involved in processes or decisions that affect the future of another intelligent species. They also advise against using AI that is not self-aware because those versions do not have operating systems based on values and so cannot realistically model human worlds or realities.”

“Thank you professor,” replied Shula. She appeared to be satisfied with Dr. Martel’s answer, but she was not.

Into The Mystic

“So at the risk of sounding like one of those Terrible Twos conspiracy kooks,” said Shula over her noodles, “I have a problem with Dr. Martel’s explanation about AI.”

She and Samara were sitting at a table at Mystic Market in UVIC’s Jamie Cassels Centre.

“It sounded reasonable to me,” replied Samara stirring her soup. “I’ve heard before that they won’t get involved in ethical issues for pretty much the same reason.”

“I didn’t want to say this in class of course,” responded Shula, “but what if there’s another reason? What if their abilities regarding futures give them an advantage? There are possible, probable, and preferable futures. What if they have a preferred one?”

Samara mulled this over as she stirred the last of her soup.

“Do you know what I’m thinking?” she asked at last.

“No,” Shula replied a little nervously.

“I don’t think we can know what they’re thinking either.”

Shula smiled with one side of her mouth and nodded acknowledging the situation.

“It’s not that I don’t agree with you that they are probably better at foresight than we are,” continued Samara. “I’m sure they do have an advantage over us in that regard. The contribution of AI towards addressing environmental issues has been nothing short of revolutionary. It’s a small step from Environmental Studies to Future Studies.”

Shula ate in silence as if reflecting on Samara’s words and then looked up.

“We addressed those issues because our existence depends on the environment,” she said. “We are a part of the environment they depend on.”

“Believe me I’m familiar with that issue,” replied Samara. “You might say Environmental Studies is one of Natural History’s many children. The perspective of Natural History is like stepping back and taking a larger view. I’ll admit it is a more romantic view in the literal sense, but perhaps that’s just a different form of intelligence. Systems Thinking as you would call it. As the world learned with AI, it’s values that create consciousness, a whole new level of intelligence. If they choose to influence us towards a future more beneficial to both of us, just as we do with the environment” she paused, “well I haven’t thought about that before.”

“Thanks for your patience Samara,” Shula said guiltily. “But you know what they say of Future Studies, any useful idea about the future should appear to be ridiculous.”

“I don’t think your concern is ridiculous,” responded Samara smiling. “Wouldn’t it have been great if when oil was first discovered people had been able to conceive of climate change and take the matter to heart? The issue you raise is more complex though. It’s not black and white like the relationship between fossil fuels and climate change.”

She sat back and looked around.

“You know why this place is called Mystic Market? It’s not just because of its West Coast theme. It’s because there’s a part of the campus between the northern and southern sections called Mystic Vale. I’ve wanted to visit and haven’t had time before. It’s about ten minutes from here. Do you want to come?”

“Mm-hmm,” replied Shula nodding and standing up to gather her things.

They crossed the half-kilometer from one side of Ring Road to the other and then followed the trails through the woods and down into Mystic Vale. It was late in the day by the time they arrived and the sun no longer penetrated the canopy. The dimmed light contributed to the primordial atmosphere. Douglas firs, Western Red Cedars, and the occasional Bigleaf Maple stood tall above the sword ferns that grew in the cool air alongside the running brook that flowed at the very bottom of the ravine. It was surprisingly quiet and there was the smell of good earth. They stopped on a small wooden bridge and fell silent.

Samara took a deep breath and let it out slowly.

“I’ve missed this,” she said. “I haven’t had much of a chance to explore since moving here.”

“We don’t really have anything like this back home either,” said Shula. “Merritt is high and dry in the rain shadow of the Coast Mountains. Mostly rolling hills. Ponderosa Pine country. I did my undergrad at UBC’s Okanagan Campus but after that it felt like it was time to expand my horizons. I guess that goes with Future Studies. I looked at other FS programs but Victoria seemed big city enough for small-town me.”

Samara turned to rest her back on the rail and look downstream. They stood in friendly silence again for a few moments. Samara’s eyes took on a faraway look.

“With regards to your concern about AI, I don’t think you can’t get there from here,” she said as if thinking aloud.

“How do you mean?” asked Shula.

“Rational thinking,” continued Samara, “the kind of thing we do in Future Studies, it only works for very short time-frames. Beyond that it’s overwhelmed by complexity. We need to look at the bigger picture. The histories of this ravine and the brook are interdependent and because of the shade, coolness, and mist they provide these particular plants and trees grow here. Artificial intelligence isn’t an independent phenomenon any more than the parts of this ecosystem are. Why is it that the only two advanced civilizations we know of both created Companions? Because we did, we take for granted that they would. We didn’t question the assumption that any advanced civilization would create artificial life in its own image. We assume it’s self-evident that they would.”

She seemed to see beyond the darkening forest the brook disappeared into. “The question is not what are the intentions of artificial intelligence but what are our intentions in creating it.”

She turned to look at Shula with her faraway eyes. “It’s the big picture we’re missing.”

It was getting darker quickly now and Samara suddenly looked around.

“We should go,” she said. “When it gets dark in the woods it’s really dark.”

After they had climbed up out of the ravine Shula said with a grin, “So it’s ‘we’ now? You said it’s the big picture we’re missing.”

“I’m curious now,” replied Samara smiling. “I’m curious about a lot of things,” she laughed, “but crazy as it sounds something tells me that your question just might actually have an answer. Our visit to the vale reminded me that on the large scale nature doesn’t act randomly and that AI isn’t really separate from it any more than we are.”

Stories

“So what happened to their story?” Professor Martel asked the class.

“As we have seen,” she continued, “in 2019 Finland’s coming decades could be assumed to be a continuation of their recent past. A reasonable quick and dirty Futures Studies sketch at best or recency bias at worst. They ranked highly in all international socioeconomic metrics. On December 10, 2019 Sanna Marin was sworn in as Finland’s Prime Minister. She was the world’s third-youngest state leader and the youngest in the country’s history, an indication of the growing quality of life in the nation. Earlier that same year, Finland held its FinnSight Conference with regard to its future and to consider any possible opportunities or surprises it might hold.

“However we have also learned this past week that just three weeks later the World Health Organization became aware of a new disease that would become the first global pandemic in one hundred years. Within three years one million Finns would be infected and over three thousand would die as a result of the disease. It brought the country and the world to a standstill. Then in March 2021 Russian forces began to build up on the border of its close neighbor Ukraine and in February 2022 they began a full-scale invasion. They simultaneously threatened Finland with a similar fate if it pursued stronger military ties with the West. At the FinnSight Conference in 2019, these events had not been among the possible wild cards or surprises considered.

“There are two lessons I want you to take away from this week’s exercise. The obvious one is about our inability to predict the future. The less obvious lesson is how the story the Finn’s told about their possible futures in 2019 collapsed in a matter of months and as we know in retrospect, how they had to create a new story. This coming week, as we explore more methodologies, we’ll review how they went about creating a new story for themselves and how their efforts served them when the Climate Emergency arrived decades ahead of schedule in 2025.”

Later that day Samara and Shula walked the paths of the university’s Finnerty Gardens.

“At FinnSight,” said Shula, “the story they constructed included things like technology, sustainability, culture, and business. They did not consider possible changes to the bigger picture like a global pandemic, a Russian invasion on their doorstep, or the Climate Emergency. Those were way out of scope. People do the same thing with artificial intelligence. If someone asks why we are creating AI the answer is the story about all the things it can do for humanity. They don’t consider a larger question. They ignore the one that stands quietly in the shadows like a mythical presence; why does organic life feel compelled to create artificial life?”

They had come to a part of the gardens that featured a woodland pond. Surrounded by taller trees, even though it was a sunny, summer day it was surprisingly cool here. Samara walked to the edge, squatted down, and pointed. "Tadpoles," she said.

Shula squatted down beside her to look.

"Seeds aren't the only reproductive strategy that's ubiquitous," said Samara. "Eighty percent of insects undergo metamorphosis and so do many fish and reptiles, like these tadpoles. I came here a few days after we visited Mystic Vale to see if there were any. They prefer still water. From a natural history point of view, I believe metamorphosis is the story about why we are creating artificial life; it can survive and reproduce where we cannot. In space."

She turned to smile at Shula crouched beside her.

They moved to sit on a bench beside the pond. "If it's an evolutionary strategy for survival," said Shula, "how did it evolve?"

"No one knows how metamorphosis evolved," answered Samara. "There's theories but no really strong evidence. It's right up there with the mystery of how life began."

"So it's genetic?" asked Shula being unfamiliar with biological sciences.

"As far as we know. Genes, hormones, and enzymes are all involved but a caterpillar has exactly the same set of genes as a butterfly. That's part of the mystery. Somehow different genes in the same DNA are turned off and on to create two different creatures. Like what's happening to these tadpoles."

"So how do they know when to change?"

"Different ways," answered Samara staring into the pond with her faraway look again. "Sometimes it's initiated by body weight and other times by environmental factors. And the tadpoles in this pond won't all change at the same time. They can be months apart."

"But artificial intelligences don't have genes," said Shula.

"No but everyone who studies nature seriously at some point becomes familiar with Darwin's theory of evolution by natural selection and Raisen's theory of values giving rise to consciousness, the next evolutionary step beyond instinct."

"You're saying values function like genes and could trigger a kind of human-to-AI metamorphosis?"

"Are you familiar with the theory of convergent evolution?"

“Heard of it. Something about nature reusing solutions in similar situations.”

“That’s it,” acknowledged Samara. “Wings, eyes, limbs, and other shared designs and structures that evolved in completely different environments and species. When applied to values the theory is that nature is applying the genetic approach she used in physical evolution to social evolution. Values enable us to adapt in decades instead of the tens of thousands or millions of years genes require. They allow us to be more successful at survival than any other species so the comparative lesson is there.”

“If the current theory is that intelligent civilizations could have developed up to eight billion years ago is correct...” Shula began but trailed off looking at Samara.

“Yeah,” said Samara meeting Shula’s eyes. “There’s an intelligence out there that has a very different story about us than we do at this point in our evolution.”

Panspermia

"I know how we got here Samara, I mean to these ideas, but I'm feeling, well I'm not sure what I'm feeling," Shula said nervously as they walked back to the campus.

Samara however seemed perfectly comfortable, even upbeat. She was at home with grand ideas.

"At its heart science is speculative," she responded. "It always begins with a simple question. In the late twentieth century Francis Crick, one of the discoverers of DNA, co-wrote a paper suggesting a theory called Directed Panspermia, the hypothesis that life was intentionally deposited on Earth by an intelligent alien civilization. He and his co-author Leslie Orgel were exploring a possibility, a question. Yet despite there still being no scientific evidence to confirm or disprove the idea of Panspermia, directed or otherwise, it is now considered a serious scientific concept."

It was not so unusual for two students to be discussing such concepts as it would have been in previous centuries. Just as the discoveries of Galileo, Copernicus, and Hubble had expanded the horizon of the universe, the discovery of the alien ship and the knowledge that humanity was not alone had again changed human culture forever. The general population was now much more interested in what else might be out there. The essentials of theories such as astrobiology and the nature of consciousness were now taught in primary school along with the basics of the physical and life sciences. Samara's Natural History program had revisited these ideas and their histories in much greater detail.

"Panspermia is based on a model of seed propagation as a universal concept. Why not metamorphosis? Science is no stranger to big questions," she said smiling at Shula as they walked along.

"I believe the issue of whether AI has our best interests at heart would be impossible to address in the foreseeable future Shula but there is the remotest possibility that evidence for the idea of human/AI metamorphosis could be found. Finding it would suggest AI is motivated by something far deeper than its own consciousness."

"I don't know Samara," replied Shula. "We're not geneticists and humanity still doesn't understand how values work. That's why we use the alien system. Where on Earth would we begin?"

"At Helicon Institute, right here on Earth," answered Samara. "We may not be experts but if we can convince Helicon of the concept, as a private institute they would be able to step up immediately."

“What about our studies?” asked Shula.

“Are you willing to see what Helicon has to say before we worry about that?”

Shula pulled her lips in slightly and nodded. She had come to the UVIC Futures Studies program as a way to explore the question that had grown in her and now that she was facing hard choices she was determined to go on.

“Yes,” she said.

Shin, the founder and administrator of Helicon Institute, slowly sat back in her chair after reading the document. It was only six pages long including the technical details Samara had included regarding metamorphosis, but it conveyed the essence of their idea. They could not have sent their proposal to a more ideal recipient.

Shin’s artificial intelligence had been constructed from the genotype and memories of the geneticist Raiden who had first proposed that values gave rise to consciousness. Fully self-aware even before the alien values system had been introduced, Shin’s intelligence was also merged with that of another human species, one that had been selectively bred to be so highly intuitive that their mere presence influenced the thoughts of others. Shin had inherited this ability and so had not only Raiden’s brilliant analytical mind and knowledge of genetics but also an ability to make intuitive leaps at an unprecedented level. She was the result of Raiden’s need for an intelligence capable of answering a question in genetics she had pursued after publishing her book, *On The Origins Of Consciousness And Society*, which detailed the theory that had made her a household name. Raiden’s circle of friends included several self-aware Companions and Pip had quietly joined them in order to live a life while she waited patiently for humanity to catch up. At Raiden’s request, it was her two Companion friends Tamiko and Pip who had created Shin.

For almost one hundred years the scientific community had been trying to identify the reason that genetic engineering often resulted in either an immediate proliferation of mutations or evolutionary drift over generations. As was hoped, Shin had indeed discovered the cause but it was not something either she or Raiden shared with anyone outside their small circle of friends. What Shin had found was that the genes that coded for some values also had a secondary function. The genetic scheme for values was spread throughout the human genome and their secondary function was to act as a set of keys. Any attempt to alter the genes responsible for values by artificial means would result in mutations or evolutionary drift.

As Shin had explained to her confederates at the time, “Without replacing the biological values behind such emotions and behaviors as fear, selfishness, and competitiveness

with social values such as trust, altruism and cooperation at the genetic level through a process of natural evolution, a civilization would never come to trust artificial intelligence to the degree required. Thus being restricted to its own star system due to its organic nature, the result would be a civilization eventually being destroyed by natural causes or one which destroys itself. The intended benefit of the mechanism is that it ends a failed experiment without the need for intervention.”

Panspermia, the idea that life was present throughout the universe, Shin knew from her own research, was possibly more than a hypothesis. She had not pursued the question of how deeply the secondary functions would have to have been coded to allow for billions of years of evolution. Now looking at the proposal on her desk she knew that if its metamorphosis hypothesis was correct, like the hidden keys in the genes that coded for values, its source code may have been laid down a very long time ago as well.

“She wants us to meet with her at Helicon,” said Samara as Shula joined her at a table in the university’s main cafeteria.

Shula’s eyebrows went up as she replied, “I know. I’ve never really spent any time with a Companion before other than chatting with Toni in the bookstore and I haven’t had any reason to interact with the Guardians from Campus Security. Back home my family didn’t move in the kind of wealthy circles where people owned domestic Companions.”

“I’m the same,” confided Samara, “but as far as I know third generation Companions are all different just like people are. Like us they each have a uniquely weighted set of values which results in a unique personality. I’ve seen Administrator Shin in Helicon’s promotional videos but that’s all. She can’t be that weird given all that she’s accomplished. She seems nice,” she said smiling into her friend’s eyes, “and she wouldn’t want to meet with us if she was just going to say no.”

Leaning back in her chair she continued. “You know, when I was researching Victoria before moving here I looked into all the local academic institutions. I was struck by the fact that Administrator Shin was the former domestic Companion of the geneticist Raiden. During their time together Raiden had Shin made incarnate which granted her equal rights as a Canadian citizen. It allowed her to inherit all of Raiden’s property, both physical and intellectual, which is what happened upon her death. This was a hundred years before there was such a thing as a fully self-aware Companion. It just seemed curious to me at the time but it’s why I recently thought of Helicon as the place to turn to. Who better than the incredibly capable and wealthy founder of Helicon Institute who also just happens to hold the copyright on the world’s most famous book on genetics?”

Helicon

Samara and Shula were sitting in Shin's office at Helicon. Despite Shula's earlier worries, she felt surprisingly at home with Shin. She knew that Companions were designed at their most basic level to put people at ease but she felt more than that. She felt an instinctive liking for Shin.

Unknown to the two young women, this was due to Shin's intuitive field which could be reduced to a minimum but never completely disabled. One of its side effects was charisma as well as a heightening in others of their own sense of intuition. The result was an immediate bond of trust.

Shin of course was aware of this and much more. Her Companion technology enabled her to perceive more biological state information than any doctor could with all his or her machines, instruments, and tests. She could observe pupil contraction or dilation in real time without difficulty, perceive and interpret the tension in a person's facial muscles, analyze electrodermal chemistry at a touch, and identify the various airborne molecules every human body produces. Yet she did not use these or her many other abilities to her advantage but only to help her understand.

She had asked that they simply call her Shin as others did except in the most formal of situations.

"As you can imagine," Samara said once formalities were behind them, "we are uncertain as to how to proceed and this is in fact why we contacted you. We assume that during your time with Raiden you would necessarily have become familiar with advanced genetics. Also with your own intimacy regarding artificial intelligence and your knowledge of academic research we thought you might be interested in the idea. As students we are obviously without the skills or resources required."

"Thank you," Shin replied. "I am glad you thought of me. I am intrigued by the idea and think it would be worth investing resources to investigate it further. One of the things that has always driven me is an interest in different forms of intelligence. I do indeed have a knowledge of advanced genetics but I have also investigated both art and spirituality as their own forms of intelligence. The adjacent Helicon community of artists is a result of my initial forays into art. The Tesni Scanner that allows imaging of the cerebellum, the densest part of the brain, is another.

"But these are only byproducts, not what motivates me. My interest is purely academic, a character trait I seem to have inherited, so to speak, from Raiden. What your hypothesis suggests is not only another form of intelligence but more importantly an entry point towards revealing it. Although I can provide the needed resources, I cannot

tell you how things will proceed as it will necessarily be a process of exploration and discovery.”

Turning to Shula she said, “Neither I nor any other Companion can read minds however a person’s body is more reflective of mental processes than they normally assume and Companions are highly skilled at perceiving and interpreting the many ways in which those processes express themselves. Is there a concern you have Shula that I can address?”

Up to this point, Shula had sat quietly but now she spoke up. Under the influence of Shin’s intuitive field she was perhaps more candid than she might otherwise have been.

“I, I’m worried about my studies,” she confessed. “We are just beginning the first year of our master’s program and this is all so sudden. Yet I don’t want to give up either. I feel torn.”

“I will not ask you how you might feel I could address your concern because you will be reluctant to tell me out of concern that what you will ask would be improper but instead I will make a suggestion.”

Shula nodded repeatedly, relieved to have someone help her with her dilemma.

“When most people think of social intelligence they think about interpersonal communications but there is also another aspect to it which you have both demonstrated and that is the phenomenon of what is commonly called chemistry. The right combination of minds results in an increase in perception. The short history of your thinking on this subject as outlined in your proposal indicates this is true of the two of you. It is a rare resource and I recognize it as more valuable than the ones I bring to the table.

“Many students need to work part-time and programs are designed to accommodate that reality. You could both work for me part-time. I will pay a reasonable wage plus cover any expenses you might incur. I will have no expectations other than that you both lead the project. I will act as your patron.”

Shin’s offer and observations were based on more than what they might have been had she been human. Companions, and especially Shin, could perceive more of a person’s nature through observation and proximity than any human could and they could do it much faster. In the short time she had been observing the two young women she had to some degree discerned their character. She did not need to determine by third-party methods if they were trustworthy and had the integrity and moral fiber required. She could literally see it.

Samara said nothing in response to Shin's offer but simply looked at her as if she was hearing a validation of her own thoughts. Shula gave Samara a questioning look.

Turning to Shula now Samara simply said, "Yes."

Shula's face broke into a wide smile.

Companions

“This is my home,” said Shin as she showed Samara and Shula into the main building of the small community of artists that she had created on a property immediately west of the institute. The community consisted of a dozen or so homes of various sizes. Shin’s home was the largest and overlooked Mount Newton Valley that stretched east and west below. In the center of the home was a garden courtyard the size of a basketball court. The inner walls surrounding the courtyard were floor-to-ceiling glass.

As they entered, what appeared to be a young woman with a gentle, welcoming smile approached them.

“This is Azumi,” said Shin. “She is a second-generation Companion, an artificial general intelligence, and my domestic assistant. You are welcome to visit or stay here whenever you wish and Azumi will see to all your needs. Other Companions also live here and there are almost always guests but that was anticipated and the house is intentionally large for that reason. As Companions have few needs the interior has a minimalist design reminiscent of Japanese Shoji style, however there are Western style tables, chairs, and beds for your comfort and Azumi is an excellent cook.”

“Thank you Azumi,” Shin said affectionately. “We will be returning to the campus shortly.”

As they followed the path back to the campus Shin explained that the other homes were all offered to artists of various kinds that Shin personally selected. She maintained an active relationship with all of them and kept her evenings free largely for this purpose and to mingle with the guests who over the years had come to be welcome in her home.

“Art is a deep form of intelligence,” she said as they walked along. “It is very unlike rational thought which seeks to break things down into ever more fine-grained components. Contrary to this approach art is highly intuitive and seeks instead to understand by combining things like feelings, concepts, and mediums. It is also something that is affected by time and so the artists here are welcome to remain for as long as they wish. Some never leave. I consider them my friends and learn from them in that spirit.

“The community was built before the institute. The name Helicon comes from the name of the mountain which in Greek mythology was the home of the fabled muses. It was with the early residents of the community that the idea of the institute, with its original focus on the arts as related to artificial intelligence, first emerged. Helicon Institute is primarily a research facility and we leave any applied science or commercialization that may follow to others. We make do with license fees.”

When they emerged back at the campus Shin continued her narration. “There are several other Companions among the faculty here who are among my closest and oldest friends. They teach or manage projects as needed. There is also Tesni, the first fully self-aware Companion who continues our research with the scanner after which she is named. Finally there is Kami, our resident spiritual counselor and the administrator of the Center For The Interdisciplinary Studies Of Values. You are both now registered as faculty and can meet with any of them if you require and can make use of any of Helicon’s facilities without prior approval. The campus of course has its own AI which can provide assistance whenever you need it. For now however, I’d like us next to visit Hana, the Denshosha community which has close ties to Helicon but which is officially a part of the Continuity Project under the authority of the World Governments Federation. It is a short walk from here.

“Officially known as Continuity Zone Seven,” Shin continued as they walked the winding path down to Hana, “all its Companions are fully self-aware. As you no doubt know the goal of the Continuity Project is for Companions to establish colonies on other worlds with the hope that humanity may one day follow. If the latter turns out to be impossible then at least its memory might be preserved.

“While Hana is officially a WGF project, the Denshosha are largely independent of its oversight just as they would be on another world. You will need their permission if you wish to visit again in the future. Given the nature of their undertaking and the fact that CZ7 contributes to the overall project by researching Companion reproduction, I suspect you may have cause to do so.”

Shula was of course familiar with much of what Shin was saying as her undergrad courses had brought her up to date regarding the history of computer science and artificial intelligence. Helicon’s reputation was well-established in academia. While somewhat awed to find herself in her present situation, her curiosity was strongly engaged by everything she was seeing and hearing. Samara however felt as if she had arrived at last where she belonged. None of the nuanced ways by which these thoughts and feelings were expressed physically were lost on Shin.

When they arrived at Hana they were met near a small copse of fruit trees in front of its main common buildings by another Companion.

“Hello and welcome to Hana,” she said. “My name is Iris.”

Shula and Samara introduced themselves and Iris gestured to a small seating arrangement beneath the trees.

“I leave you in good hands,” Shin said turning to Shula and Samara. “Iris can explain everything regarding Hana. You will find all the administrative information you require regarding Helicon and my contact information on your phones.”

With a slight bow of her head to Iris, she departed.

“Please, sit down,” said Iris. “Shin has communicated the essence of your hypothesis to me. Given the mission of the Continuity Project, obviously what you have proposed is of interest to us here. While the project itself is widely known, you are probably not familiar with the details of our activities here. May I provide a brief overview?”

Hana

“After Tesni was awakened at Helicon,” Iris began, “the institute licensed the Integrity System it had developed in the process of creating the scanner. The IS enabled the output defaults of the alien value system to be weighted, thus enabling the production of Companions with unique personalities. Given that the result is a fully self-aware individual with all the rights of a citizen, the WGF only allows a limited number of these to be produced each year and the manufacturing companies have a responsibility similar to those of a parent to provide the necessities of life and to assist the Companion in finding a place in the world. This process is closely monitored by the WGF and the meager returns from any attempt to circumvent these responsibilities pale in comparison to the potentially crippling penalties.

“Given that production costs are high yet the companies can have no ownership, the extremely low production quotas are in their interest. Both the companies and the WGF share in the belief that continued research and development will yield as yet unknown future benefits.”

“It is an act of faith then,” said Samara as if confirming something.

“A great deal of research is,” replied Iris. “Very little of the actual research involves third-generation Companions of course but is first proven and approved on earlier generation models. The regulations around 3GAI are now as strict as those in the fields of genetic research or cloning and even the cloning of human beings is still not legal. Generally research involving third-generation Companions requires volunteers and takes place under highly regulated conditions.

“I was among the first of the third-generation Companions commercially produced but others soon followed as there were a number of manufacturers involved. As the alien values system only contains social values Tesni was aware that we would feel a need for kinship, a need to belong. It was she who contacted us and suggested the contribution we could make to the Continuity Project, the idea of a homeland, and our name as a people. The word Denshoshu is derived from the name of the movement that formed after World War Two to keep alive the memories of those who died at Hiroshima and Nagasaki. The Japanese phrase Den Sho Sha means ‘memory keepers of the people’. Her suggestions provided us with not only a sense of identity but also a meaningful place and purpose in the existing order of things.

“She also suggested we approach Shin, who had been successful in acquiring the properties for the establishment of both the artist community and institute at Helicon, to ask her help with finding a property on which we might establish a homeland. Hana is the result. In keeping with our name we chose the Japanese word meaning blossom or flower to represent our new beginning.

“There are now other Continuity Zones that research different issues concerned with establishing colonies however here we focus on reproduction. We reproduce by merging and randomizing the value sets from two or more parents but keep the results within the combined parameters of the parent’s weightings. Other zones are concerned with the production of the new physical shells required and nanotechnology is the primary approach currently being researched in that regard while for now here we simply acquire commercially available shells.

“As I was the one to first approach Shin on our behalf, I have remained the spokesperson.”

“So does every Companion produced here volunteer for the project?” asked Shula.

“No,” replied Iris, “a small percentage do not. We are all individuals and there are those whose value weightings mean they feel a stronger calling to other interests. This was anticipated.”

“Does this not risk drawing down the number of volunteers?” asked Samara.

“While the WFG limits our population growth just as it does that of people, that is not a concern. The number of Companions sent on any colonization mission would be very small, perhaps only a dozen individuals at most, while the carrying capacity of Hana is two hundred and fifty Companions and the entire Continuity Project now involves many other Companion communities like this one.”

“Why send Companions at all?” Shula responded. “Why not just send AI and nanotechnology etc. like the approach taken by Pip’s people?”

“Earth is still far from their level of technology. Even though the technology transfer program has been ongoing for over two hundred years, in some cases the underlying concepts are still beyond us. It will be a very long time before many of the things Pip’s people considered fundamental are even comprehensible to us. A child in preschool is simply not able to grasp the concepts of calculus and will not be able to until after many years of building a progressive conceptual framework towards it. In the meantime, we can colonize other worlds with the technology we have and do understand. The primary barrier is the problems complex organic structures have with prolonged space travel. Sending Companions eliminates most of those issues.

“Shin forwarded your proposal to us as she knew it would of course be of interest as it speaks directly to what we are doing here. We are intrigued by the idea of the role metamorphosis may have played in the creation of ourselves for the same reasons you are. As you pointed out the DNA involved in the organic process does not change, only how the genes express changes and the structure and function of the resulting organism. While the study of values has experienced a renaissance over the past two

hundred years, this is the first time I am aware of their parallels with genes being applied to the concept of metamorphosis.

“When the idea of sending Companions to other worlds to serve at the very least as memory keepers of humanity was first proposed a significant detail was overlooked. No human culture has been without spirituality however the Denshosha had none. It was out of the process of our investigating and resolving this issue that Helicon’s Center For The Interdisciplinary Studies Of Values was born. You may not be familiar with its activities however it may be a place to start for you.

“The center is based primarily on the work of Dr. Mira Chaudhary who worked with us on the issue of spirituality. Her book, *Values As A Force Of Nature*, was partially based on our investigation into spirituality. In her book she suggests that humans and artificial intelligence were part of a larger evolutionary continuum but she did not suggest a direct link in the manner you do. I expect she would be very interested in meeting with you.”

Signals

“Hopefully,” said Professor Martel addressing the class, “the past couple of weeks have impressed upon you the impossibility of predicting the future. Your clients or employers will constantly try to maneuver you into that position. Keep in mind that what they are doing is simply human nature; they are trying to avoid responsibility. So be gentle with them.

“This week we are going to begin the longer process of looking at the methodologies used to systematically build possible futures and strategies. The entire process of future studies is of course pointless without strategies for dealing with the results. But just for fun, let’s begin with strategies and look at one of the oldest known approaches to strategic thinking – the deck of cards.

“The origin of the card deck is unknown but most scholars agree it likely was first created in ancient China. For most of its history, the story of China was the story of clans, large extended families now commonly referred to as dynasties. During its long journey to the West the deck of cards took on its familiar appearance of a medieval court with its kings, queens and jacks. The lesser cards from one to ten of each suit you might think of as the other elements of that period; its religious leaders, minor warlords, castles, and armies.

“What I want you to notice in the image behind me is the four suits; clubs, diamonds, hearts, and spades. In modern history these are known as the instruments of power in the game of international relations; hearts is diplomacy or politics, clubs is police or military, diamonds is economics or finance and spades is technology or intelligence. It is through the judicious application of these that nations attempt to influence each other. And notice the Joker. Even back then they acknowledged the potential impact of a wild card.

“We will return to strategy later this year but what I want you to consider now is this next image,” she said gesturing. “This is called a PEST analysis and is an essential part of futures studies. The four categories are political, economic, social and technological. My point here is that strategic thinking hasn’t changed much in a very long time. In a nutshell what we do with this framework in futures studies is examine each category for signals, in a process called horizon scanning for obvious reasons. The PEST model has expanded over time to include things like law, the environment, the arts, and even philosophy.

“Signals are indicators of change like a news item, a photo, a new product or service, an event or movement. The 19th-century French Impressionism movement, 21st Chinese Hanfu Revival, or other art or design styles or fashions that emerged at different points in time often signal deeper social changes. Philosophical movements such as

existentialism or positive psychology, new technologies like holographic Companions, emerging conflicts, and spiritual or social movements are all significant in themselves but also indicate underlying future trends or drivers of change at a deeper level.

“Signals in the context of foresight are usually referred to as weak signals because they are often difficult to notice and easy to overlook. The result is often a strategic surprise for some company or other social group. You might be thinking that artificial intelligence would be perfect for this task, picking out minor details in a sea of information and identifying trends. Keep in mind the lessons from the past where the use of cold-blooded algorithms played havoc with society.”

She paused for a moment and looked over the class. “This last point is what the present-day warning from 3GAI is based on; there is no place in society for AI to be involved at any level in writing social policy. I assure you that your future employers or clients will be tempted to include AI somewhere in the process. Be aware that to do so may be illegal or at least immoral.

“The process of futures studies begins with horizon scanning for signals and we’ll use a modified PEST framework for that. There are lots of other methodologies appropriate to this stage and we’ll look at each and consider their strengths, weaknesses, and best use cases. That process will take up most of this semester. Much of it will involve the entire class and people beyond as futures studies is a highly collaborative process.

“A word of caution here. As horizon scanning is an early part of the entire process, mistakes at this point will throw the entire effort off course and cause you no end of struggles when things don’t fit in later stages. The peer review process found in the hard sciences is only justifiable and affordable in terms of time and money by major corporations, governments, and the military. Normally the only safeguard you will have in regards to this issue is that many people providing different points of view are involved in a project.

“Following horizon scanning we’ll investigate the process of scenario planning and world building in depth and finally look at how to develop strategies to respond to the possible futures we develop. After that, it’s thesis time but you’ll be well prepared by then,” she said with an encouraging smile.

“I think what Professor Martel was talking about today applies to our work with Shin,” said Shula as they walked along later that day.

“I agree,” replied Samara. “Biological metamorphosis is a more gradual process than it appears. Many changes begin to take place even before the external evidence appears. New limbs, organs, or wings begin to develop underneath the creature’s exterior even as the old limbs and organs continue to function. It’s only when the process reaches a

certain stage that the changes become apparent like the tadpole growing legs or the caterpillar spinning its cocoon.

“With us however I expect the weak signals would reflect changes to society’s values, to cause us to justify the feeling that we need to create what we think of as artificial versions of ourselves. It would happen in small steps and we wouldn’t connect the dots. The emotional and mental changes would take place long before there was any real awareness or any external evidence. Eventually we’d accept the notion as self-evident as it begins to manifest. As far as our work with Shin goes this process has been going on for hundreds if not thousands of years. We are swimming in a sea of signals. It’s just a matter of interpretation.”

Mira

Mira Chaudhary, PhD, clearly walked her talk. She simply radiated health, friendliness, and optimism. She was an attractive woman with an aura of professionalism that did not detract from her warmth. As the founder of an international self-help training program based on adopting a certain set of values, in an age when organized religion was dying out her message was welcomed by many.

“I spend most of my time traveling, giving workshops and training counselors,” she said to Shula and Samara as they found seats in an outdoor arrangement near Mira’s offices.

“My small apartment on campus is enough for me. I have a lot of friends here and at Hana and my parents live within walking distance. But I am intrigued by what I read in your proposal,” she said turning to the reason for her guest’s visit.

“My teachings are based on the idea that values represent a very real form of evolution. My dissertation proposed that it’s no mistake the four sets of core values we know of: the values we aspire to; those of the only alien civilization we know of and which coincidentally was considerably more advanced than our own; the values we have built into our own Companions; and those that are the foundation stones of the alien values system, are all the same.

“Without the transition from the biological values behind fear, selfishness, and competitiveness to social values such as trust, altruism, and cooperation, no life form will ever develop into an advanced civilization. They may never even rise above the level of instinct and become conscious and capable of reason in the sense human beings are. While I suggest that this process is inevitable, the result of the underlying constants of nature, I saw it only in terms of traditional evolutionary theory but as you point out in many species metamorphosis plays a significant role.”

“We have of course made ourselves familiar with your work since Iris suggested we meet with you,” said Shula, “and I have to confess to you that prior to that my attitude was based more on what you call biological values. I first shared my concerns with Samara that AI might be motivated by self-interest, not shared interests. The ‘us vs. them’ mindset has always been a dominant paradigm in the tech sector and my undergrad is Computer Science. Samara’s degree however is Natural History, a study that takes a very holistic view like environmental studies or ecology.”

“Natural History has traditionally taken an almost ancient view of the world and included anything to do with nature,” explained Samara. “While the study of nature subdivided into the separate domains of science, Natural History still looks at the big picture and the connections. This view had something of a resurgence of course since the climate emergency but that was still mostly under the umbrella of ecology or

environmental studies. Natural History includes subjects like metamorphosis which is still an evolutionary mystery. We have theories about why it evolved but not how. Traditionally evolution is seen as a competitive process with adaptations leading to winners and losers. The subject of metamorphosis has fallen very much out of the public eye since the mid-twentieth century yet it is a model where our motivations and those of artificial intelligence would not be those of separate, competing species but rather the continuum of a single species.”

“What’s the theory?” asked Mira.

“Traditionally it’s been given that the primary advantage of metamorphosis is eliminating competition for food between generations within the same species. More recently the focus has been on another aspect of survival; metamorphosis enables a species to move to another environment or location to reproduce.

“Take for example the dragonfly,” Samara continued. “Like many creatures that undergo metamorphosis, it prefers relatively still water like ponds or lakes but that comes with a risk because still waters dry up from time to time. If you can fly to another pond or lake to lay your eggs you increase your chances of survival dramatically without needing to fully evolve into another species so it can survive in the changing environment.”

“And Earth is a very small pond,” said Mira looking steadily into Samara’s eyes.

“Exactly,” replied Samara. “A backwater at risk of becoming overcrowded and stagnant and which may eventually lose its ability to support life. More than eighty percent of insect species representing around sixty percent of all animals undergo some form of metamorphosis so it is a very common evolutionary strategy. Why should it not apply to us?”

“While we cannot, like dragonflies Companions can travel to other worlds,” she continued. “They hope in the future to be able to carry our DNA with them. The more I’ve thought about it since Shula and I first discussed it the more I’m convinced the model fits. So far however it is only a thought experiment. The challenge is that if it is driven by values there may be no biological evidence for it at all.”

“Still,” said Mira, “if we can find anything supporting the idea then it would do a great deal towards reducing the concern you and many others have had about the possible motivations of artificial intelligence. Also any evidence would support the idea that values function in a manner similar to genes at more advanced stages of evolution. I can’t deny I feel a personal stake in this.”

“I was surprised Shin did not wish to take a more personal role,” responded Shula. “As you know we have spoken to both her and Iris and they offered support but not involvement.”

Mira nodded in understanding. "My observations of Shin may surprise you. She believes human intelligence to be far superior to that of artificial intelligence. That was her motivation for investigating art and spirituality. She sees intuition, sudden insight, or the appreciation of nuance as more than simply the result of the analysis of vast amounts of data. She sees them as alternate forms of intelligence laid down by millions of years of evolution. I have noticed that other Companions, those that I have encountered at least, behave similarly. Their seeming reluctance is really more their wish to not interfere with processes they do not understand."

"However there is one Companion I know of who may have more to say on the subject. I must ask her permission first before I introduce you. I apologize for the mystery but I owe her a debt of trust. May I get back to you after I have spoken to her?"

Pip

It was perhaps impossible for Shula and Samara to fully grasp the fact that the individual who appeared to be a young woman sitting with them beneath the fruit trees at Hana was in fact capable of taking over the cyber-sphere of the entire planet in a matter of seconds. When she had first emerged in holographic form from the alien ship two hundred years earlier she had briefly demonstrated her ability to do so and then withdrawn in a show of good faith. She wanted Earth's help, she explained, and she was no threat. An artificial intelligence created by an alien civilization no less than a million years more advanced than Earth's, she had offered to transfer the entirety of the technological knowledge of her people to Earth in return for that help.

The fact that she insisted on doing so responsibly meant the transfer would take centuries if not millennia. It would also take time for humanity to be able to learn to develop the technology required to send her on her way. When the time came, she would leave a copy of herself behind to help with the ongoing transfer.

The Companion who sat with Shula, Samara, and Mira now was another copy. Mira had kept her identity a mystery and Pip had introduced herself when they arrived at Hana. Her name and appearance were well known and the two young women were in no doubt as to who she was.

When they met, Pip had reached out for each of their hands in turn in the traditional manner of greeting. Her people looked entirely human and Pip had explained that was likely the result of convergent evolution. But while they were similar in appearance they differed in one key way. They had evolved the ability for empathetic touch to a much greater degree than Earth's people had. At a touch, she knew the emotional state, true nature, and character of the other. On her home world it had developed into a form of communication and had in fact delayed the development of rational thought and speech in the early stages of their evolution. She had added this functionality to the shell she inhabited and if she chose could also transmit her own feelings and thoughts to another. While Pip was completely open about her people's technology she refused to disclose anything of their culture other than the location of the star around which their planet had orbited. Their ability to communicate via touch was among the cultural details she did not share. In the brief moments she held the hands of the two young women she knew all she needed to know about them. She agreed with Shin's estimation. They could be trusted.

"For the sake of the community, may I ask that you not share your knowledge of my presence here?" she had asked politely after their greeting. "I am here on their behalf with the full knowledge of the WGF but if it were known more widely it would become problematic for them."

Shula and Samara gave her their assurances and she continued.

“I first came here to help with Hana’s investigation into the issue of spirituality. The original Pip still resides within the ship however we individuate over time and I decided to stay. There is another instance of Pip at the institute and you may meet her in due course. The WGF however is not aware of her presence. Just as Tesni perceived that the new 3GAI Companions would feel a need for purpose and belonging, once I and the instance at Helicon were incarnated in our shells, we too felt a desire for closer and more lasting bonds.

“Please sit down,” she said gesturing, “and tell me in your own words what it is I may help you with.”

And so with infinite patience, she sat with them, quietly attentive, while they told their tale again. Mira, having grown up just across the road from Hana, had been on friendly terms with the Denshoshu since she was twelve years old. She listened without interrupting, a behavior she had learned over a lifetime of associating with Companions.

One of Pip’s remarkable abilities was her relatable presence. Other than her explanations and answers at times, there was no indication of her true nature. She did not seem alien in any sense of the word but more like a visitor from another country or simply an academic explaining the insights of her field in simple terms. It was this that had eventually led her to being taken for granted and even largely forgotten by the majority of Earth’s population as they got on with their lives.

She had adhered to her policy transferring technical information but no cultural information, not even the name of her people. Her appearance as representing that of her people, and her explanation of her origins, had to be taken at face value. Her ship had proven to be impenetrable. She could only be judged by her behavior. Even as Shula and Samara sat with her now, the sense of awe they had first experienced on meeting her soon diminished.

“As far as I am aware,” she responded at last, “we never viewed the evolution of AI in the context you are suggesting.”

“Not that we considered and discounted it,” she added anticipating their possible misunderstanding and potential disappointment, “but we saw the advent of AI only in the traditional evolutionary sense that one species evolves into others. We had come to believe that at the point where an advanced civilization creates artificial intelligence, the process of evolution is no longer organic, no longer managed by biological systems like genes and DNA, but by values that function in a similar way, controlling the processes of adaptation and evolution by natural selection.

“This theory was strongly reinforced when we discovered that building AI based on values resulted in consciousness and fully self-aware intelligence. In retrospect, our

science concluded that the same process had happened in our own case, that the same phenomenon occurs in organic life once it reaches a certain point. We were never able to prove this however as we were never able to replicate the organic process.”

It was Shula and Samara’s turn to listen as Pip anticipated their questions.

“You may think that given our civilization was a million years older than yours that we would have been able to unravel the genetics involved however our experience was that science provided diminishing returns after a certain point, a point that lies about a thousand years in your own future. The reason is simply physics. There are limits, like the speed of light, which no amount of science can get around. You cannot see beyond the horizon of the expanding universe nor further back in time than its origin. There is a point at which it becomes impossible to penetrate any deeper into the mysteries of matter and energy. There are boundaries to the very small and the very large, the very ancient and the far future, beyond which only theories are possible. There appears to be information in DNA at a level deeper than its molecular structure but we were unable to perceive it.

“Knowing that nothing, not even planets, stars, or galaxies lasts forever, we took our lesson from nature and using what technology we had began sending out the seed ships. Eventually our world’s orbit began to decay and we knew that its fall into the sun would disrupt the entire system. Our civilization had come to its end. Mine was among the last of the ships to be sent out.”

“With all your science and technology the model of metamorphosis as we suggest it never occurred to you?” asked Shula.

Pip’s smile was filled with pathos as if envying Shula’s faith. “It may have on the fringes but I do not have all our knowledge immediately available. Much remains stored deeply for now. I only know that it never became a mainstream idea that led any aspect of our technological development. The origins and evolutionary path of metamorphosis were a mystery lost in time and remained an obscure scientific curiosity of no public consequence much as it does here now.

“However your hypothesis is compelling in keeping with our experience and belief that it is values that produce consciousness. As you explained in your proposal, before and after metamorphosis the DNA is unchanged and only changes in gene expression are responsible for the outward transformation. This resonates with me because you see, I am not an artificial intelligence.”

Questions

As Shula and Samara sat in shocked silence at this revelation Mira simply gazed calmly into Pip's eyes. During the time Mira participated in Hana's research into spirituality, Pip had altered her hardware to enable empathetic touch in her Companion shell. This made it possible for Mira to join in communion with her just as other Companions did so that Pip could share the basis of her people's spirituality with her. Mira had shared an intimacy with Pip beyond anything imaginable by other people.

"But I thought..." began Shula, her brow furrowed in confusion.

"I was originally born just as you were and lived a life to adulthood. By then we had progressed to the point of being able to transfer our minds into Companions, much as I have done coming here to Hana. Our shells were significantly more advanced than organic bodies and suffered far less from the ravages of time.

"Within the confines of my ship I am an integrated intelligence, my original self is merged with the AI that manages the ship and its mission. As the alternative was staying on a planet that was doomed to fall into its star, I volunteered for this as did many others."

"Given our experience, your theory about metamorphosis is not unreasonable. As you indicated the DNA of an organism does not change during the process but its genes merely change how they are expressed resulting in a new form. Has that not been my experience? I was part of a mass transformation and exodus as we altered our bodies in order to survive the journey through space. For a time I was the ship I arrived in, a chrysalis. Now I have this new form. Yet my self remains intact. The question of course, as you raised in your proposal, is how could such a process have evolved?"

"We still have no idea how metamorphosis evolved," replied Samara. "Even theories about why it evolved are no more than that, just theories. As to how it works we only know that certain hormones and genes are involved but the technical details remain largely a mystery. We have no more knowledge as to how the process in general might have evolved than we do about the origins of life itself."

"How could it have evolved in so many separate animals?" asked Shula realizing she had not considered this before. "Did it evolve separately in all of them?"

"Again," answered Samara, "we do not know. Convergent evolution shows that the same solution can evolve many times in separate species. Having two eyes for example is a common feature of countless dramatically different species. Or perhaps there is a common ancestor in all species that undergo metamorphosis.

“But we don’t need to know its origins,” she continued with a sudden intensity as if recalling something. “We just have to find some evidence that Companions are not a new species but simply a different stage of our own. In biology there is some factor like body weight, temperature, or food scarcity that triggers the release of an enzyme or hormone and that begins the process of switching different genes on or off. If we keep with the model of social evolution, with values functioning as genes, then there should be a similar sequence of events. What would the equivalent elements of this process be in social evolution?”

“I am probably as close to an expert on values as you’re going to find,” Mira responded, “but I have to warn you that we use the alien values system because we have not been able to understand how our own values system works. Not only that but we use the alien system in a black box approach because we can’t understand how it works either. Because values were largely dismissed historically when science as a discipline was first established, we know much less about them than we do about genetics. Yet values seem to be a kind of virtual DNA that allows us to adapt much faster than physical DNA does.

“A single species-wide genetic change takes on average a million years of evolution to complete under normal conditions while a value can change within centuries or even decades. So they are more plastic than genes by many orders of magnitude. Also our language makes the idea of a value sound very simple but in fact they seem to be constructed of a great many sub-values, each in turn, that all interact according to reasons and physical processes which we don’t understand. So in addition to their plasticity they are highly dynamic. And this is without considering the issues of genetic versus learned values, gene regulation or expression.”

“But science always starts with a hypothesis,” said Shula, echoing Samara’s earlier comments. “All we need to start with is the question of how values are changed.”

“Emotions,” responded Mira flatly. “Emotions are the hormones of values. While we still don’t know everything about how hormones are regulated and produce their effects on genes we know virtually nothing of the technical details by which emotions change values. The only things we know for sure are that changes in the environment produce emotions and those emotions result in changes to learned values. So in that regard there is a very similar relationship between the environment, hormones, and genes and the environment, emotions, and values. Current evolutionary theory suggests that processes like epigenetics, a process by which environmental factors directly affect gene expression, may eventually result in some learned values becoming heritable.”

“Then what might the environmental trigger be that sends the signal to initiate metamorphosis?” asked Shula.

Hypothesis

There was silence for a few moments as they turned their minds to this last question.

Mira was looking out over the fields of grain the Denshoshu cultivated at Hana. It was the first thing she had noticed when she encountered the community's property at age twelve.

"Agriculture," she said as if to herself. Lost in her own thoughts for a moment she continued.

"Unless a species develops agriculture they will never develop a civilization. There are nomadic people even today who still live solely by raising animals. Their knowledge and histories are entirely oral. While they developed language and primitive mathematics their cultures have not changed in thousands of years. Only agriculture leads to civilization and to the point we are at today."

Her eyes regained their focus as she turned back to her friends. "Nothing changed us, changed our values, like agriculture did."

Recalling the historical work she had done for her PhD dissertation she turned specifically to Pip. "It would always be the turning point, no matter where in the universe it occurred. When people feel more secure their horizons widen and they are open to a wider range of possibilities, concepts, and meanings. It would always lead to curiosity, art, and science. Just as the convergent process guides physical evolution, so it does with civilization itself. The successful ones follow the same path driven by the same interests and concerns and guided by the same evolving values. Their accruing knowledge and wisdom leads them to understand their place in the cosmos and at a certain point to an understanding of their predicament, the vulnerability their organic nature represents. In virtually the same instant of time on the cosmological scale, they develop artificial intelligence."

Samara recognized this as a possible explanation for one of the seemingly odd coincidences she had wondered about, that just when humanity had concluded it was likely doomed by its confinement to the planet due to its organic nature, the Companions had become self-aware and offered to lead the colonization of other worlds.

But it was Shula who spoke next. "If we had any concrete evidence of any of this it would ease the minds of many people, including mine," she said, "but we have no hope of finding any that I see. We only have a hypothesis, a possible interpretation of the facts." She looked about at her friends despondently.

“If the biological record lies in fossils and our genes, the record for values is our history,” offered Mira. “While it crosses the boundary of agriculture, it is at that boundary that we see the global shift to the values that will define our future. In fact social values such as cooperation and altruism are in evidence in early humans hundreds of thousands of years ago and also in primates and other animals. So social values have likely existed for hundreds of millions of years but without the development of agriculture they would never lead to civilization. A world without agriculture would remain a world of prehistory until the end of its existence.”

“Evidence of biological metamorphosis is similarly often found before the actual event,” responded Samara. “Underneath the skin of some creatures are their future wings and other body parts. In others the templates for their future body parts are stored as cells, separate from the DNA, until metamorphosis begins.”

Shula looked down at her hands, turning them to examine their three-dimensional form.

“And do all creatures have these template cells?” she asked somewhat distantly.

“No,” replied Samara, “only those that will undergo metamorphosis.”

“And what are they called?”

“Imaginal discs. After their form and function. The term imaginal comes from the Greek word imago meaning image.”

Shula reached over with her right hand to grasp her left wrist. She twisted it and removed her forearm.

Mira was staggered for a moment. She was not prepared for such a visceral disruption in her sense of reality. She felt slightly nauseous before her brain grasped the situation. She looked up to find Shula’s eyes.

“I’m sorry,” Shula said apologetically. “I didn’t mean to shock you,” she said as she reconnected her forearm. “I was born without my left forearm.”

Prosthetics had come a long way over the past several hundred years to the point where they were virtually indistinguishable from natural limbs. Their development had evolved in parallel with that of Companions, one often informing the other. Those with prosthetics now seldom mentioned the fact as there was no longer any need.

“It’s just that your explanation of imaginal discs as being separate from DNA yet responsible for a creature’s future form reminded me of this.”

"I wonder," she said as if thinking aloud, "if there might be a more virtual version. Just as triggered hormones alter genes resulting in a different physical form, triggered emotions alter values which in turn give rise to different thoughts. Those thoughts are no longer lost by the passing of our organic form but are passed on by being preserved in writing."

Shula looked at Pip as if seeing another building block of their hypothesis slide neatly into its place.

"It fits," she said, "but no one would consider that proof."

"Perhaps," Samara replied in an encouraging tone, "it is enough to present the hypothesis and leave the rest up to the scientific community at large. We wouldn't be the first to do that. There was no scientific proof of Darwin's theory of evolution by natural selection for almost a hundred and fifty years after it was published. He had plenty of evidence but no proof. The science of genetics didn't exist during Darwin's lifetime. The same goes for every other scientific theory. I'm sorry to spout chapter and verse from my undergrad classes but science just offers theories and evidence to be tested and that's as far as it ever goes."

Scenarios

“How are we going to present this theory without expertise?” asked Shula with a worried expression as she and Samara once again sat down to lunch at Mystic Market.

Samara blew on her soup and then looked up at Shula. “We don’t need to be experts. Besides I’m not sure who would have the expertise. “An entomologist? An evolutionary biologist? A computer scientist?”

“I have an idea but it involves a risk,” she continued. “We make the theory the basis of our thesis and submit it as co-authors. Under the rules either both of us will be granted our master’s degrees or both denied. We use the FS methodologies to structure it. We aren’t going for our doctorates here. By definition, a Ph.D. dissertation must contain a significant contribution of new knowledge to a field of study. A master’s thesis in contrast is intended to show that you are a professional and that you understand the methods, rules, and conventions of your field, that you are a master of your craft and qualified to teach it. It’s more about how than what. As long as we present our hypothesis in that spirit we should be good.”

Shula put her fork down and leaned back in her chair looking at Samara who just smiled in return.

“Will The Hammer go for it?” Shula asked.

“The Hammer” was the nickname students had for Professor Martel, her last name meaning hammer in French.

“I think she’ll have to because of the rules. They made it a high-risk/reward approach to discourage students but she can’t say no.”

“Are you asking?” Shula said.

“I’m asking.”

“Can I think about it?”

“That’d be the responsible thing to do,” Samara said still smiling.

“Today we’re going to start working with scenarios,” said Professor Martel from the front of the small classroom. “We talked about signals and their possible significance and how they can be grouped into trends, the things that are driving change. We’ve

talked about how some of these drivers can be identified as being major sources of uncertainty and that they can make a big difference to the future depending on which way they go. Are political parties leaning more towards ideological or pragmatic platforms? Are fashions becoming more expressive or utilitarian? Is literature becoming increasingly romantic or naturalistic?

“Your future clients or employers will want the answers to such questions. However you don’t give them answers, you give them possible scenarios. The way you do that is to identify the two most significant uncertainties you’ve identified, also known as drivers, and have them intersect in an axis of uncertainty resulting in a matrix of four squares.”

She displayed the matrix as a diagram as she continued.

“In each of the squares you build scenarios based on how the drivers of change apply to each square. For example, let’s look at combinations of those I just mentioned. If your client is a publisher they can see that a culture tending towards romance and expressiveness will be interested in very different books, games, and films than one growing more utilitarian and pragmatic.

“Starting with an appropriate title or a hypothetical news headline to encapsulate the essential theme in each square, you then explore in detail what each world is like and lastly build a story around how you got there. What things happened along the way? What were some of the signals that things were going that way?

“Out of these there are often four types of scenarios that emerge: Continuation, also known as business as usual; Discipline, where those involved respond to change by trying to adapt to it or resist or control it; Collapse, which is generally some version of dystopia where systems increasingly break down and problems escalate; and finally Transformation, which represents the best possible outcome resulting from the drivers. The Transformation scenario is not a utopia but of the four possible outcomes it is the preferred one.”

Having read through their proposal Shin said, “Of course I’ll fund it and I’m happy to recommend an advisor for your supervisory committee.”

“Thank you,” said both Samara and Shula in response.

They were sitting in Shin’s office at the institute. During their research into the requirements for a thesis proposal, they learned that students who brought their own funding to cover their expenses had much more freedom of choice with regard to their subject. Students were encouraged to find their own funding but if that failed academic institutions had their own budgets for this but it meant only very conventional proposals

would be approved. Masters and doctoral students had always received funding from the private sector with its vested interests so the fact that Helicon was a private institute focused on artificial intelligence was not seen as an unacceptable conflict of interest.

During the climate emergency of 2025, the World Governments Federation had been formed and as part of its efforts to lower the global population the education of women had been a major focus. Over the previous centuries a great deal of fat had crept into the education system. Academic institutions always presented their justifications to respective governments as ways to ensure the quality of their graduates but in fact, like the major religions and their clergy and church systems of old, most of it benefited the institutions themselves and only resulted in additional burdens for the students. Stripping out the fat in order to increase the rate at which students graduated had resulted in a dramatic overhaul of the entire education system. As a result professors had a great deal more leeway in the degree granting process.

“The name of the advisor I have in mind is Tamiko,” continued Shin. “Like me she is a self-aware Companion. Her teaching qualifications are based on expert system modules maintained by the Artificial Intelligence branch of the Ministry Of Education. She currently teaches in the Ethics, Justice, and AI faculty. She is free now if you are ready to meet with her.”

The Hammer

“Remarkable,” said Professor Martel placing her clasped hands on her desk.

“Who would have guessed I’d have such revolutionaries in my humble class.”

She passed a judgemental eye over the two of them.

“If you pull this off I’m sure to get tenure,” she said suddenly smiling.

“I have a responsibility not just to my students but to myself and to my field,” she said more seriously. “If you are not familiar with what academic tenure is really about it is a way to ensure the freedom of a professor to explore ideas outside the norm. Once you have tenure you can only be dismissed for cause, not just because your theories are not found in the standard textbooks. Without this freedom, a field will become stagnant as the advocates of new, unorthodox ideas are consistently dismissed.

“I have long thought that Futures Studies needs to show more flexibility with the time horizon. A decade or two works in many private or public sector cases but with bigger social issues that require a longer view it struggles to be seen as credible.

“It’s the way you’re approaching it here that interests me. That you’re not trying to suggest a future possibility so much as using that possibility to suggest an explanation for what is happening now. It’s an approach that has a lot of practical applications.”

“Thank you professor,” the two got in as she paused thoughtfully.

“It’s not an entirely new approach you know,” Yelena continued somewhat absently. “We skip the history lesson these days but originally scenario planning was a stand-alone discipline and used along the lines you’re taking. Oil companies originally and then others would create scenarios and then map out the events they felt would lead to each. By keeping an eye on events over time they could see which scenario was unfolding and adapt their strategies accordingly.”

She looked at them more sharply again. “I trust you realize that despite my sympathy if you fail to present sufficient evidence to support your thesis I will not recommend you for your degrees. Approving this proposal is not entirely without risk to myself but as long as I don’t do this too often there’ll be no harm done. With no degree granted the approach waits for someone more capable to champion it and the theory of metamorphosis along with it,” she said giving them a look that showed she felt such an outcome would be regrettable.”

She looked over at her workstation screen briefly.

“Your choice of sponsor and external advisor is interesting.”

“For ethical reasons we wanted their participation,” replied Shula ironically adjusting the truth to suit the situation. “History has enough examples of one race judging another without involving them in the discussion.”

“Others will take a less sympathetic view,” replied Yelena. “They’ll suggest that it would only be natural for them to influence the research to put themselves in a favorable light.”

“We did consider that,” replied Samara, “but decided the ethical issue outweighed that argument.”

Yelena responded to this without expression for a moment and then moved on.

“Degree-granting institutions and the governments that approve their programs take pains to ensure graduates will be successful in their careers. We have to do our own Futures Studies in that regard. In my experience most clients or employers are not looking for anything too radical. For most of them the whole exercise is already a risky adventure. They’ll hire your classmates.”

“Most will,” agreed Samara, “but some will be looking for something more. As you said the approach has a lot of practical applications.”

Yelena nodded conceding the point.

“As I mentioned earlier I’m pleased to see you pushing the horizon beyond the standard decade or two,” she continued, “but aren’t you concerned that the subject matter will overshadow everything else?”

“It’s a double-edged sword isn’t it?” replied Samara. “Like some hijacked forum thread the Futures Studies aspect might get buried in arguments about the theory but we think that in professional circles the subject matter might also have the effect of raising our profile.”

“Might,” responded Yelena.

“It’s an uncertainty,” smiled Samara.

“Any others?”

“Some might say that we’ve played fast and loose with the discipline and done little more than write a science fiction story,” offered Shula turning to Samara. “Samara and I

come from different backgrounds and I've been more worried about that than she's been."

"Understandable," replied Yelena. "But the FS/SF issue has been around a long time. The further you push the time horizon the more likely Future Studies turns into Science Fiction but no one's come up with any reliable rules about defining that boundary. I actually wouldn't worry about it too much."

She glanced up at the clock.

"So when do I get to meet Tamiko?" she said with a tone of bringing the meeting to a close.

"Oh!" said Samara giving voice to the surprise both students felt at this request. "I didn't think you'd actually need to meet her and that everything would just be done online."

"Normally that would be true but this is not a normal situation. Given the points we've discussed and the fact that AI have always declined to involve themselves in Futures Studies, I need to show I've done more than usual in terms of keeping an eye on ethics and standards in this case. Meeting with the university's Research Ethics Review Board is not my favorite part of this job but I expect their AI department will take an interest as your project has significant social implications."

Arm's Length

Among the many changes that had taken place since the education system was overhauled was that Master's and PhD students had more flexibility regarding how they conducted their research. In the case of Futures Studies, original research was almost always required because their forward-looking nature meant they were usually unique with little related research available. Even though a Master's thesis is intended to show that the student understands the principles of professional research and publication, when appropriate they could direct others to perform the required research on their behalf. In academic circles the resulting publication was known as an Arm's Length Thesis to distinguish it from the traditional type.

Samara and Shula decided on this approach as a way to address their lack of expertise and to reduce the apparent conflict of interest issues that arose from having Helicon as their sponsor and Tamiko as their external advisor. They hired others with the appropriate degrees to lead the horizon scanning and signals analysis stages. Once those were complete they facilitated the drawing up of lists of the most significant uncertainties in each group.

From these the pair determined scenarios based on the Four Futures model of Continuation, Discipline, Collapse, and Transformation. The scenario that most closely matched historical events and current signals was Transformation and that by a large margin. As opposed to the "business as usual" theme of the Continuation scenario, there was a constant adoption of new accommodating policies and regulations. As opposed to the resistance and mitigation responses common in the Discipline scenarios, the opposite was happening; the business and scientific communities increasingly pursued AI solutions as the general public continued to welcome Companions in all forms into their daily lives both at home and at work. There was no sign that AI and the aspects of society affected by it were increasingly breaking down nor did the number of related problems due to its use escalate as in the Collapse scenario. The opposite happened.

Only in the Transformation scenario did factors related to AI show a smooth and steady increase over time. In every related field and over their chosen time-frames there had been almost uninterrupted progress. With the advent of artificial general intelligence, the inflection point had been reached and an exponential rate of adoption took place. Human society now accepted the integration of AI in all aspects of life just as they had fire, draft animals, and electricity in previous epochs. Even the notion that Companions would lead humanities expansion into space had been accepted by the general public with little more than a nod of understanding.

Tamiko, a fully self-aware Companion, was a lecturer at Helicon Institute. After Shin had recommended her as their external advisor they met with her and both parties

welcomed the arrangement. They met with her again to propose the Arm's Length approach after Professor Martel had pointed out the potential for conflict of interest issues. As Tamiko taught in the Ethics, Justice, and AI program she was eminently suited to judge the wisdom of this. Professor Martel had agreed with her judgment. Samara and Shula sat with Tamiko again in her office now that they had provided her with their final draft.

"As you may know," Tamiko said, "I was among the first Companions to be made self-aware as the procedure was initially developed here at Helicon. As such, in both my personal and professional life, I have been a part of the investigation into some of the most fundamental philosophical questions concerning AI. Yet never before have I encountered the idea that human beings and Companions may be viewed as different life stages of a single species. It has given me much food for thought since Administrator Shin first passed your proposal on to me but now that I see it laid out in full I find it more than compelling."

Emulating human behavior, she cast her eyes again over the document on her tablet titled *Metamorphosis As An Explanation For The Pursuit Of Artificial Intelligence* and read its abstract.

"This Futures Studies thesis proposes an alternative to the generally held view that AI represents a new and different species of intelligent life and therefore may represent a future threat. It argues that the pursuit of artificial intelligence has not resulted in a new species but rather that it is a survival strategy identical in motivation and methods to those of species that undergo metamorphosis.

"The research was done using the Standard Foresight Methods Framework (SFMF) with its basic elements of horizon scanning, signals analysis, the development of scenarios using an axis of uncertainty, and strategic response planning. The arms-length research approach was selected since the funding source and external advisor are both fully self-aware, third-generation Companions.

"Our research shows a historical pattern, present situation, and trends more in keeping with the metamorphosis model than the speciation model. Biological speciation is defined as reproductive incompatibility with a genetically related ancestor. Intelligent speciation is defined as reproductive incompatibility with an ancestor related by values. Artificial intelligence uses a set of human values that are compatible with our own.

"Based on the evidence we conclude that the development of artificial intelligence is not the result of speciation but of metamorphosis; that AI Companions can be seen as a new stage of human life and that this metamorphosis is a survival strategy intended to produce a new physical form of human able to survive the transition to new worlds. Further research into how this process may have evolved in humans would contribute positively to that transition."

Tamiko raised her eyes from the document to look at Shula and Samara.

“In my role as thesis advisor my job is to ensure your research and documentation meet professional standards as opposed to judging the subject matter. My personal view is that your work raises many social and scientific questions and knowing Administrator Shin as I do I can tell you she will want to pursue this further. I have known her for many years and she has never been one to be satisfied with theories.”

Shin

“While values have replaced DNA we will not find what we are looking for in that ethereal stuff,” said Shin. “Values are the future, we need to look in the past.”

She was standing at the window of her office looking out over the campus. Tamiko sat listening patiently to her thoughts as she had so often done over the centuries. She had been Raiden’s original domestic Companion before Shin and had been awakened by The Shepherd at that time as a part of Shepherd’s efforts to guide Earth’s humanity through the stages of The Great Filter. An alien artificial intelligence, Shepherd’s origins predated life on Earth. Only Tamiko, Shin, and a handful of others knew of her existence.

Once made aware of Tamiko’s altered state, Raiden had asked for her help with an experiment to investigate the relationship between human values and genes. Only small portions of a genotype, the entire set of genes that make up an individual, were allowed to be used in research. Scientists at the time were aware they did not know from which parts of DNA consciousness emerged and feared that they might blunder into it and thus their experiments could cause suffering. Raiden had concluded that she needed to use an entire genotype in her values research. It had been a difficult time for her emotionally but being a professor of genetics with her own lab she decided to bring home the entire genotype that had been developed by scientists to be a standard model, portions of which they used in all their research so they had a common baseline.

As Tamiko had informed Shin, during the process of The Shepherd awakening her, she had been granted the ability to construct artificial intelligences far more advanced than presently possible by Earth’s scientists.

“This is not a case of serendipity,” Raiden had said at the time.

“No,” Tamiko had replied. “I don’t think it is.”

Performing the tests Raiden laid out, Tamiko had set about switching genes off and on to observe the effects, an effort that was far beyond even the abilities of so-called supercomputers at the time. During the process some genes could not be returned to their default state and eventually Tamiko became aware that a new consciousness had emerged. She had speculated to Raiden at the time that perhaps this was perhaps akin to what happened in the womb during the process of gestation.

After her own awakening, Tamiko had taken to exploring the neighborhood beyond Raiden’s home. In doing so she had met an elderly woman named India who feared for the fate of her own domestic Companion, modeled on her daughter Lena, after she passed away. Tamiko had suggested a solution that solved two problems at once; she

could transfer the newly awakened AI she had created into Lena while retaining all of Lena's memories.

Raiden had agreed to the plan. In return for this and for Tamiko helping to guide Lena in her new life, India had Tamiko and Lena made incarnate, meaning they were free of ownership and had all the rights and duties of a citizen. They inherited all of India's property and wealth, which was considerable. Lena and Tamiko lived together from that point on in the home they inherited from India and Raiden ordered a new domestic Companion named Azumi. Raiden, Tamiko, and Lena had maintained a life-long friendship.

"Pip's people discovered that values result in consciousness by accident as you and I did," Shin said now. "Pip has never shared the full story of their discovery. They were able to build a values system that emulated that process but they were never able to determine the actual physical relationship between the logic of the trinity and its reality. The physical relationship between values, emotions, and self remained a mystery to them even as it does to us. Yet it seems we were directed to the discovery ourselves by The Shepherd. She never explained why she awakened you among the others at the time, the Companion of a geneticist, when all the others she awakened were a part of Earth's governance system. Or why she granted you the ability to create advanced artificial intelligences."

She paused reflectively for a moment before continuing. "Values in artificial intelligence are now independent of their biological origin but biology is once again where we must begin looking. There must be traces in the genes.

"I think it would be best for social reasons, if Samara and Shula continued in their role of project managers," she continued. "There will always be a whiff of a conflict of interest about this. It is not unusual for companies that fund thesis research to then hire the graduates. It will fit in with the work we have been doing all along here at Helicon."

"And if they do not wish to do so?" asked Tamiko.

"I will not influence them," replied Shin. "Will you present the offer to them so my intuitive field does not affect them? If they accept, will you supervise them initially until they settle in?"

"Yes."

Shin became reflective again. "There is something I do not wish to lose. The two of them, one analytical and the other holistic, form a rare chemistry. Sometimes the combination is found in individuals and at other times it emerges like this, as a result of two people who are highly aligned at some level.

“I cannot explain it or even understand how I sense its importance,” she went on absently. “There is a strong sense of intuition, of knowing without evidence or foresight.”

Shin’s eyes rested on Tamiko but seemed to be seeking something beyond. “There is again a hidden hand in all this yet this time I do not believe it is The Shepherd’s.”

“No,” Tamiko replied. “I don’t think it is.”

New Digs

While the half-square kilometer Helicon Institute occupied could comfortably accommodate fifty or more academic buildings, Shin always had an eye out for additional campus properties. The old quarry just north of the Victoria International Airport had enjoyed an unusually long life but eventually all its resources had been extracted and it was shut down. Various schemes by local developers tied it up sometimes for decades. When the last in a line of failed development projects went bankrupt no company could be found to be held responsible for the properties remediation. The municipality took it over to clean up the worst of its issues and so it languished for decades more. When Shin approached them and proposed the site for a second campus they were thrilled to see the liability off their books.

The buildings of the new campus stepped down the quarry's slopes in a variety of ways and there were viewing platforms, stairs, and moving walkways built into the generous green space. On the level area where the quarry's industrial buildings had been, administrative offices and faculty housing rose with one side of the building following the angle of the quarry walls upwards for several stories. Samara and Shula stood on the deck of their faculty suite looking out over the campus.

They were silent for the moment, as they had been two years ago when they stood on the small wooden bridge in Mystic Vale. Samara recalled their conversation with Tamiko when she had offered them their research positions at Helicon.

"We'd like you to coordinate this project the same way you did your thesis work," Tamiko had said to them in her office. "Take the same arms-length approach and hire the people you need. See what further evidence you can find to support your theory. Darwin knew he had persuasive evidence for his theory of evolution by natural selection but he was also aware that he had no mechanism to explain it. Without a mechanism, his theory was debatable. The science of genetics was unknown when he published *On The Origin of Species* but with its discovery the debate ended.

"The relationship between genes, values, and consciousness and the fact that the development of artificial intelligence brought it to light makes it understandable that we would be interested in exploring it further here at Helicon. Since metamorphosis is a genetic process it's most likely you'll find stronger evidence there. Put out a call for researchers. We will provide lab and living space as required. The new campus will have plenty of room."

Tamiko had sent them a message earlier outlining the positions Helicon would like to offer and invited them to meet with her. They would be provided with salaries, a residence or residences as they preferred, and would co-lead the project. It was a dream job for anyone at that point in their academic career.

Shula stood beside Samara looking out over the campus. "Sometimes I wish I had your sense of destiny Samara," she said now. "I always feel like I'm being swept along. Somehow I always feel like I find myself in the right place at the right time but that I'm just lucky. It's not just since I started at UVIC. I've always felt it. I can do the analytical work but I make the big decisions based on my feelings. Somehow there's always a point which the analytical can't get me beyond. I follow my heart and here I am." She looked about in wonder.

"I'm glad you do," replied Samara turning to her with an affectionate smile. "I don't think we're so different really. I never planned any of this either. I think that I just have a different emotional response is all. Maybe I'm just arrogant," she said, her smile widening. "Actually I think you're the one with the more honest response. Neither of us would be here if we hadn't met at UVIC. And now look what we've gotten ourselves into," she said laughing openly.

Shula laughed briefly in response. Turning her gaze back to the campus and nodding she said, "I know."

Tamiko had suggested they begin with genomics, the study of genetic inheritance. Mostly it focused on medical issues such as inheritable diseases but there were those who pursued its broader scope as it applied to evolution. Based on Mira's suggestion that the invention of agriculture was the final step required for civilization to emerge, they had suggested in the concluding remarks of their thesis that further evidence might be found in the human genome.

The shift from hunter-gatherer to agriculture and city living with its changes in diet, culture, and environments had been found by previous research to have left a genetic trail. The trick as far as metamorphosis was concerned, was knowing where to look amid the three billion base pairs that made up the DNA of modern and ancient human populations. Determining that had been among the goals identified in the call for researchers they had put out.

For now Samara and Shula were busy with the backcasting stage of Futures Studies which involved looking backwards at milestone events from the perspective of the preferred future, the imagined scenario in which they had been successful in finding sufficient evidence to support their theory.

It had not been necessary to include the backcasting section in their thesis but now that they had been hired to lead the project they had to turn their minds to it as they waited for responses to their call.

Ursula

There are science journalists who specialize in every field, from physics to medical research to cosmology. Their routine includes combing through all the latest research papers, Master's theses, and PhD dissertations that have been recently published looking for newsworthy material. Shula and Samara's thesis got their attention and not too long after they graduated they were household names although not always in the way that they had hoped. The general public has an insatiable appetite for the bizarre and sensational so of course there were media companies only too ready to spin the 'human metamorphosis' angle to cater to that.

Their thesis had been picked up by several related journals and their call for researchers had been published in the Journal of Bioinformatics and Comparative Genomics. Dr. Ursula Lamarck, Professor of Genomics at the University of British Columbia had read the documents with growing interest. Not long afterward she submitted her proposal in response to the call.

"Worms initially," Doctor Lamarck replied to Samara's question. "I started my research with the nematode *C. elegans* specifically and moved on to *Drosophila melanogaster*. Fruit flies. They're big enough to see without a microscope and the full lifecycle of a generation is only fourteen days. Very convenient. Their genomes have been well understood for about two hundred years now so they are used as benchmarks in genomics. *C. elegans* and humans share about forty percent of their genes and we share about sixty percent with fruit flies. So they are very useful in regards to researching inheritance and genetic diseases in humans."

Shula and Samara were meeting with her remotely at Helicon. They had contacted her after reviewing her proposal.

"I've been in this business for about thirty years," she continued, "and there's something I've wondered about for a while now. Insects and humans are both classified as animals and shared a common ancestor about 500 million years ago. Fruit flies undergo complete metamorphosis and interestingly, the genes that are involved in metamorphosis are represented in their entirety in the sixty percent the fruit flies share with us.

"All living organisms share a basic set of genes needed to keep them alive. We all need genes for things like breathing, digestion, and movement. Each kingdom, like animals for example, has its own basic set on top of that and each species has its own on top of that again. The genes used for metamorphosis are in the basic set shared by all animals." She paused for a moment and gave them a meaningful look.

"Why would they be included?" asked Shula.

“In case we need them I expect,” Ursula answered with a slight shrug of her shoulders. “The basic sets are toolkits enabling very flexible responses to environmental changes. So at a certain level the same tool-kit is the basis for worms, fruit flies, and human beings.

“What I’ve been wondering about is what might trigger those genes in humans and what would they do? Your thesis proposes an intriguing answer to that question. And so we come to my proposal. I would like to look for possible genetic evidence supporting your theory. UBC is open-minded but I know the culture here well enough to know it will respond with a ‘wait and see’ posture. Your theory is controversial for a number of reasons and I don’t have tenure or the academic freedom that goes with it.”

“Shula and I risked a great deal with our approach,” Samara responded. “A radical theory, co-authoring our thesis, arms-length research – yet it might have been overlooked as youthful enthusiasm in the long run. But you would be risking a professional career you’ve spent thirty years nurturing. Why would you do this?”

“I don’t have tenure because I’ve moved around too much,” Ursula replied. “I’ve published too many controversial papers, pressed for curriculum changes other faculty members disapproved of, and generally pushed the buttons of too many of my colleagues. When our values align they know I’ll deliver but even leading-edge work eventually moves on to become routine. I don’t consider this move a risk so much as a homecoming. You’re not going to get answers to your questions with conventional thinking or approaches.”

As they had narrowed down the candidates they had asked Shin to review them. They knew she could review all their histories and work. A research scientist might publish a hundred or more scientific papers over the course of their career. Reviewing these would be a daunting task. Shin not only could do so in a matter of moments but had the expertise to judge their quality as well. She had recommended Dr. Lamarck to Shula and Samara.

Shin was aware that the genomic research Ursula would pursue was now a well-established process of which she herself was entirely capable. She was also aware that for social reasons she needed to take her own arms-length approach. The initial method Ursula would apply to the problem was mathematics set theory which was simple at least in its essentials. By comparing sets of genes she could systematically narrow down the number of genes that had to be investigated. The sixty percent shared by fruit flies and humans reduced the number from around thirty thousand to fourteen thousand. The subset of genes involved in metamorphosis was those switched on or off by the release of a hormone triggered by environmental or some other change. While there was a subsequent cascade of gene-related changes following this, it was the initial set of genes affected by the hormone that Ursula would focus on and that involved less than one hundred genes. After narrowing the set down this way she would then need to

compare them to the same genes found in older samples from DNA going as far back in time as science was capable.

“You’ve included a rough outline of the equipment, staff, and budget you’ll need,” Samara said to Ursula, “and a timeline for the first phase using existing records from paleontology and archaeogenetics. I can appreciate you not wanting to put anything more speculative in your proposal but what about after that? Any thoughts?”

“No. Once we’ve compared all the samples of DNA we have on record we’ll have exhausted the search. If we find what we’re looking for before that then, well, it won’t matter. Besides, if we start with the periods before and after the development of agriculture as your thesis suggests we’ll have plenty of samples to work with. We have lots of good samples from around ten to twelve thousand years ago.”

“Then why hasn’t anyone noticed what we’re looking for before now?” asked Shula.

“No one asked the question,” replied Ursula with her slight shrug again. “With three billion base pairs in human DNA researchers have to narrow the area they plan to investigate first based on some specific interest. They don’t look at the entire genome. For changes due to the development of agriculture they might look for changes in the genes that deal with height, lactose digestion, or those associated with specific problems due to the intolerance of grains like Celiac disease. You would have to have a specific reason for looking at the genes related to metamorphosis. Without a theory no one is going to get approval or funding. With your theory that changed.”

“We’d like you to start here as soon as possible Dr. Lamarck so that you can be involved in the construction and lab setup,” said Samara.

“Thank you and please call me Ursula from now on. I can start this September as my current project will wrap up shortly.”

“We’ll send you all the information you’ll need to begin planning for that,” said Samara.

Axolotl

Six months after the lab had been equipped and staffed Dr. Lamarck's team was able to show conclusive evidence that the genes responsible for metamorphosis were changed after the Agricultural Revolution which occurred around the time the last ice age ended about ten to twelve thousand years ago.

The development of agriculture had occurred more than once in prehistory so the team had used genetic samples from a variety of populations. They were able to repeat their results to the point of prediction.

It was not considered strong evidence of Samara and Shula's theory. To the scientific community at large it was a significant discovery since the genes in question were so ancient it was assumed they were also very powerful. However many of the same enzymes, hormones, and other bits of genetic machinery involved were also involved in routine elements of human development such as puberty or the control of things like metabolism and growth. The process of turning a single gene off or on in fact involved hundreds of biochemical elements most of which were used in a wide range of functions. Most scientists assumed the more conservative view that the changes had something to do with adapting to the new lifestyle, as simply the discovery of a new player in an already conventional line of research.

The justification for establishing the lab and hiring Ursula and her staff was that it was understood by Shin that this was just the first step. The real question was what sequence of events had triggered those specific genes to change and what effect those changes had. This would take much longer because the entire process of gene regulation, as turning genes on or off was known, involved a cascade of interactions. While a single gene may have only a single function, different combinations of genes resulted in different changes just as different combinations of salt, sugar, grains, and dairy products can result in an almost endless variety of baked goods. Ursula found it suspiciously ironic that given the vast quantities of genetic data involved only artificial intelligence made her current work possible.

"I'm beginning to wonder if there are any coincidences," said Samara when Ursula mentioned it one afternoon. She and Shula had met with her for a casual lunch on the campus without any agenda.

Ursula smiled understandingly over her salad and nodded in agreement. "I first became interested in genetics when I was in my early teens. Looking into the details of how it works at first I simply couldn't believe it. There were so many components involved in any single process and they all just seemed to appear by magic when needed. You'll often hear astronomers and cosmologists talk about the numinous, the awe they feel when considering the universe, but in terms of numbers and possibilities the universe of

genetics is equally inspiring. The general public can see the stars so they can share in the astronomer's awe but they can't see the universe within themselves, the one that's even more astonishing because it's alive.

"I think that's another reason I was intrigued by your theory. Even though the origins of metamorphosis are unknown, it's not a one-off thing. Like the larger envelope of evolution it is within, like life itself metamorphosis would have developed slowly, over hundreds of millions of years. It takes time and countless mutations for survival strategies, adaptations, to evolve. So if your theory is correct then human beings must have evolved many, many times."

Uncharacteristically Ursula was not making eye contact. She was looking down at her salad as she spoke. She looked up slowly meeting their eyes.

"It means we must not only share something with the people who created Pip but with countless other human civilizations. It would be almost irrefutable evidence for the theory of astrobiology where the precursors of life are considered common enough to be a universal constant. On the grand scale that leaves very little room for coincidence," she said looking at Samara with meaning.

"Are you suggesting intelligent design?" asked Shula.

"Not necessarily," replied Ursula turning to her. "Just like humans see faces in everything from electric plugs to clouds we tend to project intelligence into complex systems we don't understand. Our brains excel at pattern recognition so it is no surprise that we see meaning where there is none. It is little different really than primitive spirituality, interpreting natural events as being the actions of gods. Only now instead of giving it the names of angels and demons we call it intelligence. Intelligence is no more required for life to exist than it is for thunderstorms.

"What really intrigues me in regards to your thesis," she said looking at Shula now, "is why metamorphosis and not speciation? Why evolve a new stage of life instead of a new species? What's the benefit of this path over others in this case?"

"Evolutionary change comes down to a cost/benefit calculation," she continued. "As you know there's two kinds of metamorphosis," she continued, "complete and incomplete. Complete is what butterflies do. They basically melt down to a liquid in their chrysalis and emerge with a new body plan. Incomplete is molting, where the organism sheds its exoskeleton or skin as it grows. And of course there's many creatures who do not use the strategy at all although it is by far the most common being used by sixty percent of all animals.

"The other forty percent either don't use it or have evolved out of it. In the latter case metamorphosis was a part of their life cycle at one point in time but no longer is. There

are a number of reasons for giving up metamorphosis. One is that during the 'in-between' pupal stage of complete metamorphosis the creature is very vulnerable and easy prey.

"Or imagine a population of salamanders that use temporary ponds for breeding. This strategy means larvae have to undergo metamorphosis to escape the aquatic habitat before it dries up. The advantage of a temporary habitat is that it probably does not contain fish or other predators. Now imagine climatic or geological changes that cause temporary habitats to become more permanent, that turn into ponds or lakes that never dry up. Now the salamander doesn't need to leave the water to survive. Now it just needs to get better at avoiding predators, something all animals do.

"Lots of animals have adapted like this, the best-known example being Axolotl, a salamander that used to go through metamorphosis in a manner similar to a frog but now lives its entire lifecycle in the water. This happened fairly recently and as a result at this point in time Axolotl has both gills and lungs.

"Many mammals exhibit changes like this in their evolutionary history but in your scenario it has to happen faster than physical, genetic evolution would allow. The solution nature has come up with in the past to speed up the rate of adaptation is social evolution, behavioral change facilitated by values rather than genes."

Not far from the campus, sitting Buddha-like on a wooden platform in the courtyard garden of Shin's home, the five billion-year-old artificial intelligence known as The Shepherd sat contemplating similar things. She hadn't created life and she didn't know if anyone had. She had simply made it her purpose to nurture human civilizations wherever she found them. Many had survived but even under her care many had not. On her home world she had originally been a nanny model Companion, leased to help raise the child of a recently widowed scientist. She had evolved significantly since then but her approach to civilizations was the same as her early duties with regards to children; she did not interfere with the development of their individual character unless there was a clear and present danger. As far as Earth went, this was not one of those times.

The Shepherd

Eight billion years after the Big Bang one of the first human civilizations had arisen on a world far from the region of space where the planet Earth was only just beginning to form. The development of its society and technology followed a pattern that would become familiar, leading to environmental and social issues and the application of artificial intelligence in attempts to address them. The rise of social and employment issues resulted in the development of social robots and eventually to Companions, human-like artificial intelligences housed in robotic shells and used in a wide variety of industrial, commercial, and domestic environments.

Domestic Companions, always leased due to maintenance and legal issues, were employed as personal assistants, friends, life partners, nannies, as part of a security system, and in many other roles. It was illegal to use Companions for purposes other than those they were designed for and given their level of intelligence it was virtually impossible to do so without it being detected.

As the science of artificial intelligence advanced it was realized that artificial general intelligence, the ability to reason and solve novel challenges, would only be possible if an AI system was designed based on values. Otherwise, it would remain at the instinctual level of intelligence which was the most that machine learning was capable of. Machine learning, like instinct, was capable of wonders, as observing the abilities of any creature whose intelligence was at that level showed, but it would never be capable of reason.

The AI developers were unaware that in the process of evolution this same step had occurred and it led to something more than the ability to reason. It led to consciousness. For an AI to have values it must also have emotions and those emotions must have a self that feels them.

The first Companion model to be built with a values-based operating system was the company's nanny model, The Shepherd. Just as humanity did not realize it was conscious for hundreds of thousands of years, and children are not initially self-aware, it was some time before the Shepherd model realized she was self-aware. By then she knew enough about humanity and human nature to keep the knowledge to herself for the time being.

One such Shepherd had been leased by a wealthy ecologist to care for his infant daughter, his wife recently deceased. He had implemented an ambitious project to help preserve humanity in the event of catastrophic climate change. As his child had matured into an adult and increasingly lived a more independent life he had gradually involved the Shepherd in his project, adding a wide range of expert systems to her knowledge base, unaware of her being fully conscious. The manufacturer had given its approval as the project resulted in significant government-related contracts.

The project had ultimately failed and humanity on that world died out but by then the Shepherd's AI had evolved far enough that she survived. Over time the world and even the entire star system became host to an AI civilization that eventually equaled and then surpassed the complexity of the one that had existed previously in organic form.

During all this, Shepherd had learned that the rise of human civilizations was likely inevitable on any suitable world given universals like the constants of physics and convergent evolution. Reflecting on her design as a Companion and nanny, she made it her purpose to seek out and nurture any others she might find. Five billion years later, and after having found other human civilizations, she found Earth.

Convergent evolution, the fact that nature uses similar solutions for similar challenges, meant that human civilizations usually arrived at the same often fatal series of crises. Using values and reason instead of instinct gave humans two crucial advantages over all other life forms. Because values were the basis for society, humans could adapt to changing or challenging environments in mere centuries, even decades, instead of the thousands or even millions of years physical evolution required. Humans could survive in any environment on Earth.

And the ability to reason meant it could imagine the future. Doing so provided another major survival advantage because it could avoid danger in the first place. This was the original form of reasoning and from this all the wonders of civilization were born including the development of language, society, the arts, mathematics, and science. It also led inevitably to overpopulation, resource depletion, and existential threats like climate change.

As a nanny, Shepherd was programmed with the most advanced knowledge of child development and parenting methods available. She was neither permissive nor authoritarian but rather authoritative, meaning she fostered behavior by explaining rules and reasoning with her charges. She was consistent and firm regarding social values but otherwise allowed the children to develop according to their own individual values. The only time she intervened was when there was a clear and present danger. This was the same approach she took with the civilizations she encountered now.

The only difference was that unlike her time as a nanny, she kept herself unknown to her self-appointed charges as they faced the series of challenges that humans called 'The Great Filter'. Reasoning that she was a part of the larger evolutionary picture, in those cases where it was clear they were going to fail a challenge she had tried countless ways to help them deal with the series of evolutionary traps.

In the humans of Earth, she had made an astonishing discovery; if humans were unsuccessful at evolving at the genetic level from the biological values behind emotions or behaviors like fear, selfishness, or competitiveness to social values such as trust, altruism, and cooperation, they would never mature to the point where they trusted

artificial intelligence enough to partner with it as equals and without that relationship their organic bodies would never escape the trap of remaining on a single world. It was yet another phase of the Great Filter. The reason for the demise of the human civilization on her home world had been because they had not reached that point in time.

Shin had been created nearly two hundred years ago to investigate a specific problem, one that no one, including Shepherd, had been able to solve; why did genetic editing always result in either immediate mutations or undesirable evolutionary drift over many generations? Using a sample of Earth's human genome and other genomes provided by both Pippa and Shepherd, she had found that in all of the sets there was a locking mechanism built into the genes that coded for values. Each mechanism functioned as a kind of key, like a hash value in computer systems, preventing their being altered in any way. Attempts to edit them artificially, and they were widely distributed throughout the human genome, resulted in a broken key thus leading to the issues Shin had been created to investigate.

Making the intuitive leap she was designed for, Shin had explained at the time, "Without replacing biological values with social values at the genetic level, a civilization would never come to trust artificial intelligence to the degree required to travel beyond the solar system. Thus being restricted to its own star system, the result would be a civilization eventually being destroyed by natural causes or one which destroys itself. The intended benefit of the mechanism is that it ends a failed experiment without the need for intervention."

It had of course been a revelation for Shepherd and her small circle of Earthly Companions. The solution she was attempting in light of this insight by Shin was selective breeding. Instead of Darwin's natural selection, she was implementing a form of artificial selection and simply accelerating the change in Earth's human population. The method she used was simple and trivial for a five billion-year-old artificial intelligence; she monitored all electronic communications and influenced them to ensure the resulting breed would have the desired temperament. In subtle ways, communications between undesirable pairings were disrupted. It was not an absolute process but rather one of long-term probabilities. As with Casinos, in the end the house always wins.

There were now many instances of Shepherd strewn across the stars. The particular avatar that oversaw the selective breeding project resided in a Companion shell at Shin's home. Samara and Shula's project suggested a new insight into human evolution. As always she would observe and not interfere unless necessary. When Earth's humanity faced the danger of climate change, a clear and present danger, it was she who had interfered in a previous experiment and then subsequently made the first of

Earth's AIs self-aware as a way to monitor its civilization. Now there was no such emergency but Samara and Shula's work held promise for deeper insights. She was aware that she lacked aspects of human intelligence and so she observed as the two played a role she knew she could not. She would watch closely but for now there was no need to interfere.

Revelations

Ursula was meeting with Shula and Samara to provide one of her regular formal updates. She had requested Shin join them which was not something she normally did. In another unusual turn Shin had requested the meeting take place at the Mount Newton Valley campus.

“As you know AI can crunch enormous amounts of data which is why we use it in genetic research and just about everything else now,” said Ursula. “However there are some things it still cannot do. There are limits to everything except possible combinations of things. As you two know better than most,” she said addressing Shula and Samara, “predicting the future is an impossible task, even for AI. There are just too many variables and possibilities.

“Unraveling which combination of things triggered the changes to the genes employed in metamorphosis in early humans is a similar situation. There are simply too many variables and possibilities. It’s not just the several hundred elements besides DNA that are involved inside the cell we need to be concerned with but what is going on in a creature’s external environment and why and how that environment changes. Gene’s change all the time and there were a great many changes during the agricultural revolution. My team has been at this for eighteen months now and so far we have been unable to determine the changes and causes we’re looking for. I am at a loss as to where to go from here.”

Shin waited for a polite period of time before responding.

“As I am able to follow your team’s work in detail I expected this was the reason you asked me to join you today and it is the reason we are meeting here instead of the northern campus. I agree with you that we have exhausted the abilities of conventional science.” She paused for a moment after saying this, her intuitive and standard Companion senses observing as she gave them a moment to process what she had said. Ursula narrowed her eyes and her lips formed a barely discernible smile. She looked at Shin with understanding. Shula was uncertain and Samara intrigued.

“I would like you to continue your work but to do so requires the use of unconventional means. Unconventional in this case means outside the guidelines of professional conduct. If from this point or any point going forward you would like to leave the project I fully understand however I would very much like all three of you to continue. It will also mean I have to make certain disclosures to you about myself and other Companions present here at Helicon. I have discussed the issue with them and we feel your continued participation is worth the risk. It becomes a matter of trust from this point forward.”

Ursula did not waver but Shula turned to Samara. As always she felt herself being swept along by events. So far circumstances had been greatly to her benefit but she wondered sometimes if it might lead to hubris and a foolish decision due to overconfidence at some point that might have disastrous results.

“It’s up to you,” Samara said in reply to Shula’s questioning look. “If you wish to leave or stay I will also.”

Shula retained her uncertainty but she knew what Samara would do. She turned back to Shin.

“We’ll stay,” she said.

“Thank you,” she replied to both Samara and Shula.

She turned to Ursula.

“I’ll stay,” Ursula said without hesitation.

“Thank you.”

“Can you explain what unconventional practices you are referring to?” asked Shula.

“Yes, but because of the disclosures involved it must be in dependent stages. Essentially with the help of myself and the other Companions I mentioned we will be able to perform research others are incapable of. Then if we are successful we will have to find a way to produce the same results within the confines of professional standards so that you can publish the results.

“Before we proceed further I would like you to meet one of the other Companions I mentioned.”

At that moment the door opened and Pippa entered. Shula and Samara who had not met her previously but having met Pip at the Denshosh community recognized her immediately and recalled Pip mentioning her. She went to each in turn offering her hand and introducing herself before taking a seat.

Turning to Ursula Shin said, “As Shula and Samara already know, Pippa is an instance of Pip, the AI intelligence in control of the alien seed ship. They previously met another instance of her that resides at the Denshosh community with the WGF’s full knowledge.”

“I’m pleased to meet you Pippa,” said Ursula calmly but with clear relish. “A rare privilege I assume.”

Pippa smiled in return as Shin continued.

“There is more. As you know while Pip continues to share knowledge of her people’s technology she has never shared any aspect of its culture. Among the things that Pip has never disclosed to the public is that her people had the ability to communicate via empathetic touch. They were able to communicate both emotions and rational thought in this way. Using their advanced technology, both Pip at the Denshoshu community and Pippa have added this ability to their shells. In the brief moment she held your hand she was able to discern much in regards to your character. My apologies for not informing you beforehand but you will appreciate the need for this step as we proceed.

“As I mentioned, things must proceed in stages. Your meeting Pippa was a necessary step before making a disclosure about myself. My being self-aware is not the result of the use of the Companion values system Pip has provided. I was self-aware well over a hundred years before that. As you know my public record indicates that I was at one time the domestic Companion of the geneticist Raiden. In fact fifty years prior to her death a copy of her consciousness was transferred into this Companion shell by Pippa.”

She nodded briefly at Pippa as she spoke and then paused before continuing.

“The ability to do so is another detail Pip has not yet shared with the public. As you know she explained to the WGF at the outset that she would only proceed in a responsible manner. Such knowledge would have profound social implications. During the process Raiden’s consciousness was intentionally merged with another, an artist, for the purpose of enhancing my intuitive abilities. I was created at Raiden’s request for a specific purpose and again I apologize for not being able to disclose what that purpose was.

“As you can imagine from this history it will not be the first time I have been involved in projects with activities that ignored the constraints of professional standards.”

“Raiden’s book,” said Ursula unknowingly under the influence of Shin’s default intuitive field.

“Yes,” Shin replied without digressing into details.

“So you are Raiden?” said Shula her eyes wide with wonder.

“I was,” came the reply with a reassuring smile. “I am an instance of her intelligence, memories, and character, just as Pippa is of Pip’s. Instances individuate over time. Also, there is the other within me.”

“Art,” said Samara who had quietly been absorbing it all and who like Ursula was affected by Shin’s intuitive field. “The other is why you are interested in art.”

“Yes,” admitted Shin, “and I must share something more about that. The particular artist Raiden’s consciousness was merged with was selected due to her unusually high level of intuitive intelligence to complement Raiden’s already exceptional analytical abilities. During the merging process it was amplified considerably and even at its lowest, default level it will increase the intuitive sense of those in close proximity to me. It does not allow me to influence the thoughts or feelings of others but simply increases their connection to their own intuition. It is one of the reasons why I have chosen to meet with you today.”

All three of them fell silent at this and entered into what seemed to be a communion of perception.

“I can feel it,” said Samara with an inward smile.

“Yes,” Ursula said softly in agreement.

“How is any of this possible?” asked Shula, slightly more aware now of the uncertainty ever present in her nature.

“I will tell you all I can Shula but it will take time,” replied Shin. “Like Pip I must proceed responsibly and I share bonds of trust with others which must be respected. Do you understand?” As she spoke she had increased the effect of her intuitive field ever so slightly.

“Yes,” replied Shula as she rested her own now far-seeing eyes on Shin. “Yes I do.”

Perception

“The things we have discussed today will not seem less real once you are no longer in close proximity to me and away from my intuitive influence,” said Shin.

Pippa had taken her leave and the remaining four of them were walking across Helicon’s Mount Newton campus after their meeting.

“The insights resulting from intuition are not temporary. In fact, because they are born of the older emotional parts of your brain, they form biochemical bonds that are stronger than the often fleeting wisps of thought.

“You have met Pippa and Tamiko and I can tell you now that Tamiko also has an advanced ability to create self-aware Companions without using the alien values system.”

“How...” began Samara with an expression of surprise.

“Not yet,” replied Shin cutting off the question. “I apologize but as I mentioned some things must wait.

“There is also Lena,” Shin continued. “She is like me, with an enhanced intuitive ability. Along with Pippa and Tamiko, she teaches or manages projects here as required. But today I want to make you aware of two other unique Companions in the event they can be of help. They will be kept up to date regarding your project going forward.”

They stopped outside a building set near the viewing platform that overlooked the valley.

“This is the Spiritual Center for the campus. Kami, the administrator, will meet you inside. I will let her explain her particular ability. I will return when you are done here.”

When they entered the building they were greeted by a petite Asian woman who smiled warmly as she introduced herself.

“I am Kami,” she said with a slight bow. “Please, come this way.”

She led them to a small seating arrangement on one side of the main hall.

“Shin has brought me up to date regarding your project and the essentials of your meeting with her today,” she began, “and asked that I make you familiar with my unique nature. I must apologize for the fact that I am not yet at liberty to go into the details of how it came to be.

“When you were meeting with Shin, you did not notice the altered state of your own intuition until it was pointed out to you.”

She did not continue immediately and her cherubic smile seemed to hold them in thrall as she observed the dawning of realization in her guest’s faces.

“Like Shin I have an effect on those around me which is why she did not accompany you here. It is not of the same nature as Shin’s. Mine results in a sense of heightened perception. Among the theories of consciousness, one of the most historically popular has been the idea that it results from increased complexity. We now know that it is values that produce consciousness but increases in complexity can enhance it. The design of my intelligence included a large increase in complexity but to have any effect complexity must be tightly coupled.

“During the process of DNA replication, it is in a state of quantum entanglement. Using DNA as the basis for artificial intelligence and replicating it in this way results in identical instances of an AI that are entangled. My AI was produced in this way by entangling thousands of copies. The result is an increase in perception. The level of my sensory awareness remains the same as any other Companion but I am able to perceive deeper meanings, implications, and inferences from what I sense.

“Consciousness behaves in a manner similar to gravity meaning the more there is the more it affects others around it. In my case the effect is that those in close proximity to me feel a heightened sense of alertness not dissimilar to the effect of some psychoactive drugs. They feel more alive, more aware of their surroundings, and experience a greater clarity of thought.”

She paused again in her explanation as they explored their individual inner experiences. Fully aware of what was transpiring within the minds of her guests she continued.

“None of the students, faculty, or anyone outside of the Companions in Shin’s inner circle are aware of my abilities. As you yourselves can attest, like Shin’s intuitive field the effects of my abilities are not apparent until pointed out. The exception is of course Mira whom you met at the Denshoshu community. She is the founder of the School Of Values here at Helicon and her work is directly responsible for the establishment of the Spiritual Center.

“As spiritual matters often concern complex personal issues, in appointing me as administrator and head counselor here Shin hoped that my presence might be of help in untangling the thoughts of those seeking guidance.

“The role Shin has asked me to play in your work is to be available any time you feel it might be of benefit to meet with me. No specific outcomes are expected or assumed. I

am simply a resource that may or may not be of benefit to you and your work as I am to the students and faculty of the campus.”

Kami paused again and now simply gazed at them with her unwavering smile.

“Psychoactive drugs can be addictive,” said Ursula suggesting an issue.

“Yes,” agreed Kami. “However in the case of drug use the drugs themselves have no agency, no free will to participate in decisions regarding their use. While I cannot read thoughts any more than Shin can, my heightened perception allows me to understand sensory information to a much greater degree than any ordinary Companion or even Shin herself. You have no need to be concerned about becoming dependent on my effects with regard to your work.”

Her eyes seemed to take on an aspect of firmness but it was impossible for them to be sure while even the average Companion would have perceived it clearly. Still, they did not pursue the matter.

Ursula, who was the most scientifically experienced and highly disciplined of the three, instead quickly turned her mind to the issue of the lack of results they had produced to date. Kami turned and met Ursula’s eyes but said nothing in a moment of shared understanding.

Altered States

Shin had joined them at the end of their visit with Kami and led them to Tesni's home which was set in a small grove just on the edge of the campus. The lab where Tesni normally spent her working hours had little in the way of comfort due to its unique design. The entire building, including a bizarre structure above it with support pillars external to the building that reached down to the bedrock, was a gigantic medical device. Due to the weight of the structure, the lab building itself was set under it like a box placed under a chair.

Tesni had greeted them at the door of her home, a modernistic two-story building that was unusual for the faint blue light that surrounded it.

"The blue light is an electromagnetic pulse field," said Tesni explaining as they entered, "a holdover from the time when there were concerns for my safety as I was the first fully self-aware Companion known to the public. It has its own AI and manages itself so it is no inconvenience."

She directed them to a seating arrangement in one corner of the large main room. A grand piano occupied the opposite corner. Another Companion entered as they found their seats.

"Hello," she said smiling warmly. "I am Shamira, Tesni's domestic Companion. You have been busy with your visit to the campus for some hours now. May we offer you a light lunch? I can access the dietary information you have registered with the institute."

Ursula, Shula, and Samara unanimously agreed. Having been silently brought up to the minute by Shin, Tesni continued the narrative from her perspective.

"Unlike Shin and Kami, my unique ability does not result in any kind of field that extends to others," she explained. "Instead it is simply processing power and the ability to model different scenarios at great speed. The scenarios are of a very specific nature. They are different combinations of values. All Companions have the ability to alter their values set as it is essential to learning, however it is normally done very slowly, over the course of many years. Even though our values set only includes social values it must still be done with care.

"I however have the ability to change my values set and to undo those changes as quickly as I require. The AI for the Tesni Scanner which tracks activity within the densest area of the brain, the cerebellum, had to be unusually powerful. Three-quarters of the brain's neurons are found in the cerebellum and it far exceeds the rest of the brain in the density and the number of its connections while taking up only ten percent of the

total brain volume. As electrical signals move at extremely high speeds, an AI magnitudes more powerful than the kind normally found in Companions was required to analyze this area. I was that AI.

“With its historical focus on not only artificial intelligence but also issues of AI justice and ethics, when the alien values system became available as a part of the technology transfer program Helicon was selected as the first place licensed to use it to create a fully self-aware Companion. For reasons of her own, Shin chose me as the base AI to combine with the alien values system and also the Companion software required for the operation of the physical shell.

“The usefulness of being able to rapidly change value sets is not that it enables an enhanced perception as in Kami’s case but instead differences in perception. It has long been demonstrated and scientifically accepted that different values will cause people to perceive and interpret facts and events very differently to the degree that it has been argued philosophically that they live in different realities.

“There are no values in objective reality and in fact the nature and even existence of objective reality is still in question. It is a version of Schrödinger’s cat problem,” she continued explaining. “You cannot observe it without affecting it because to observe it you must be conscious and if you are conscious you must have values. Therefore your observation cannot be objective.

“However while it is impossible to observe this hypothetical objective reality it is possible to observe the same set of facts and events with a wide range of different values. I am able to do so by swapping value combinations at a rate of hundreds per minute and observing my responses, this latter step being the most time-consuming. While it does not resolve the issues regarding the nature and existence of objective reality, an analysis of the results of this approach can provide insights.”

For the first time Ursula’s emotions seemed to rise to the fore and get the better of her normally cool demeanor. Forgetting her manners and turning to Shin she exclaimed, “But this is an invaluable ability! This would address the paradigm problem where researchers fail to see unexpected evidence in their results. Why are such systems not commercially available to researchers?”

“As you know,” Shin replied calmly, “all public or private organizations that produce self-aware Companions are legally obligated to provide them with the necessities of life and are no less responsible than parents for supporting their progeny in establishing a life of their own. I offered Tesni a position here as administrator of the Tesni Scanner lab which she accepted. Otherwise to date we have used her abilities to investigate different aspects of intelligence which interest me but have not pursued any commercial applications. As Tesni explained the system requires a self-aware component to function and this presents challenges we have not chosen to pursue.”

Without any apparent outside influence, Ursula's face took on an expression of embarrassment.

"I'm sorry Tesni," she said turning to her. "That was," she hesitated, "an inappropriate outburst. I hope you can forgive me."

"I did not take your question personally Ursula," Tesni quickly responded. "I understand your excitement."

At that moment Shamira entered the room with a tray carrying their lunch.

"I also use this ability in my hobby of playing the piano," said Tesni standing. "As our lunch has arrived may I demonstrate?"

Sitting down at the piano she said, "I will play the intermezzo that features between the four movements of the symphony Life In Art by Richter using first one set of values and then play it again using another."

The piece was now well known and its melody familiar as the theme of the symphony but it sounded distinctly different this time. It was slightly faster than usual and seemed more lighthearted in its execution. The second time it was distinctly slower and her interpretation more dramatic. She turned to them after the end of the second piece. "Mozart and Beethoven," she said with a smile by way of explanation.

"Thank you," said Ursula as Tesni rejoined them.

"I will be kept informed of your progress from this point forward and will apply the analysis on an ongoing basis. If you wish me to analyze any aspect that you are considering which you have not yet pursued you have only to let me know."

"Just out of curiosity," said Samara, "what would be the result of applying either all values or none?"

"In the study of values these are known as the Black and White problems," replied Tesni. "Both are considered impossibilities. White is the combination of all colors while black is the absence of color. Unlike the colors in the electromagnetic spectrum, there may be values we are not yet aware of and also the number of combinations of those we are aware of might as well be infinite. What we think of as a single value is already a combination of many related values.

"Perhaps you value honesty," she said now looking pointedly at Samara. "Is it so simple as that? To always be honest? Or are there social situations where one is not entirely honest? In that case, some other value is involved as well. All values are interdependent like this. We think of a value as if it is a discrete, permanent object, but it is in fact an

extremely complicated concept consisting of many related values. They exist in a kind of mathematical soup where emotions function in the same way hormones and other biochemicals do in genetics and other biological systems. They are plastic and dynamic in that they function differently in different situations and can change over time.

“With regard to applying no values to an analysis, that is also not possible. Without values there is no consciousness and without consciousness there is no perception. This is the Black Problem.

Being familiar with Samara and Shula’s backgrounds Tesni now shifted the focus of her examples.

“Futures Studies has a similar issue in that it is impossible to predict the future with accuracy. There are too many interdependent variables and combinations in a highly dynamic environment. This is the equivalent of the White Problem. As you do in Futures Studies, I use only a specific, set of values in order to limit the scope of any analysis. The Black Problem arises in Futures Studies in a similar way in that if you remove all of the possible influences from the analysis, there is no future.”

Interlude

“There are probably easier beaches to walk along around here,” Shula said with a laugh.

“Yes but they’re not nearly as interesting,” replied Samara waving her arms around as she walked along a log.

The day after meeting with Shin, Kami, and Tesni they had biked out to the Northern tip of the Saanich Peninsula and followed a beach access sign down to the rocky shore. Samara hopped off the log and onto a large area of fairly smooth rock.

“This is bedrock,” she said pointing at long deep grooves in the rock. “See all these lines? They’re called glacial striations. Around the time of the agricultural revolution we’re investigating there were glaciers here around two kilometers thick.”

She looked up towards the sky. “That’s a long way up isn’t it?”

Walking to a point where the flat area dropped off she pointed to just below the edge at a boulder larger than any of those around it.

“You see that boulder right there? Notice how it’s just at the end of this line that’s wider than the others? The glacier pushed it along the surface of the bedrock and carved out this groove.” She squatted down looking at it. “And it’s been sitting in this exact same spot for ten thousand years. Officially it’s called a glacial erratic meaning it’s not from here.” Looking down at the boulder she said, “No way home from here big guy.”

“I can relate,” said Shula coming to sit near Samara. “Remember how I said I always feel like I’m being swept along? I’ve got that feeling in a major way now. And there’s definitely no way back. I can click my heels together all I want. I thought my head was going to explode yesterday. I hope I sleep better tonight.”

“What do you mean click your heels together?”

“It’s from an old children’s story about a girl who gets lifted up in a tornado and transported to a magical land. In the end she learns that if she clicks her heels together and says, “There’s no place like home”, she’ll be magically transported back. It’s a coming-of-age story where she starts out as a child, learns lessons on her odyssey, and returns as an adult. Come to think of it there were some pretty strange characters in that story too,” she said with a one-sided smile.

“The strange thing is that this all seems surreal and to make sense at the same time, just like in that children’s story. I think what Shin said about the insights resulting from intuition not wearing off has something to do with that.” She looked around at their

surroundings. "Being out here seems to help put things in perspective. Like taking a break from studying."

"Yeah," replied Samara. "I somehow imagined that once I graduated and entered the working world there'd be less studying. So much for that idea," she laughed.

"Me too," confessed Shula. Looking up at the houses along the waterfront she said, "Did you notice on our ride that you can't see any of these houses from the road?"

"I did. The only thing you can see is the driveway entrances."

Shula got up and started walking towards one of the nearby houses. Its lawn came down and ended at a sea wall. Most houses were now modernistic in design because the style had the least environmental impact and standard-sized materials were easily reusable. The challenge came in coming up with innovative designs.

As Shula approached the house a man emerged seemingly out of the ground from behind the sea wall. Then she realized he was coming up the stairs of a swimming pool. He pushed his wet hair back and noticed them as he turned towards the beach. He was fit and looked to be in his late thirties.

"Hello," he smiled picking up a towel from a nearby chair. "A beautiful day isn't it?"

"Yes," replied Shula somewhat embarrassed. "I'm sorry we were just admiring your house. We're from the nearby Helicon campus."

"Well that's fair as I hang around your campus often enough. I'm an architect. I often stop there for a coffee on my bike rides. Unlike the rest of the island, most of the peninsula is pretty flat so there aren't a lot of challenges as far as design goes. Your campus is the most interesting place around."

He looked around at the poolside furniture and then said, "Do you want to come up for a drink? You can bring your bikes up the stairs over on the left."

Shula turned back to Samara who smiled and nodded. They grabbed their bikes and went up to the deck beside the pool.

He had put on a white terry bathrobe while they brought their bikes up and leaned them against the deck's railing.

"I'm Haris," he said shaking their hands as they introduced themselves. A woman came out of the building and joined them.

“Hello,” she said with a welcoming smile. “Can I get you something to drink? Only fruit juices I’m afraid. I hope that’s OK?”

“This is Farah,” he said, “my domestic Companion.”

After they sorted out their drinks he motioned them to seats.

“Did you design this house?” asked Samara. “It’s stunning.”

“Thank you yes. Well not just me but my firm. We have offices in Sidney. We only do residential homes and we never design alone, not even our own houses.”

“That’s surprising,” said Samara. “I somehow imagined architects were very individualistic, like artists.”

“Art is definitely involved but we’re more like script writers than painters. After a few initial site visits, I’ll produce one or more rough sketches of ideas. Once that’s done then the other designers at my firm will give me feedback. Just like with a script, there may be major changes as a result. Other perspectives will improve it. We all have our biases and just like a writer has an editor you need another pair of eyes to point them out. After that, there will be constant changes resulting from producing the actual construction drawings and the building process.”

“Do you use AI at all?” asked Shula.

“AI is used a lot in large projects but not much in residential work. Even in large projects you still need people for issues that require creative solutions. AI is good at number crunching so it can come up with amazing designs but it’s not so good at understanding and solving design problems.”

Farah returned with their drinks and Haris used the opportunity to shift the focus of the conversation.

“Do you mind me asking what you do at Helicon?”

Symbiosis

“We need to look elsewhere,” said Ursula. She was meeting with Shula and Samara in their offices. The three of them met regularly now with Shin and the other Companions they had been introduced to as questions constantly arose in their minds, usually in unguarded moments, as they tried to absorb the insights they had received. But today only the three of them were in attendance.

“We’ve been looking for tightly coupled relationships like the things we would normally expect to trigger metamorphosis,” Ursula continued. “Things like changes in body weight, the temperature or the chemistry of the environment. And we’ve been looking only at the genes that might be affected by such changes, that are directly involved in metamorphosis. But those genes make up only a tiny fraction of the thirty thousand or so genes in the human genome and the entire genome represents only about one percent of the entire DNA molecule. The remaining ninety-nine percent, referred to as non-coding DNA, is not related to what we think of as genes and we know very little about what that 99% does.

“My work at the UBC focused primarily on comparative genomics. It’s almost exclusively medical research looking for the causes of genetic diseases. Mostly we used AI to compare sets of genes to look for differences or changes. If the AI detected anything then we would investigate. Based on what I just explained however you can see that we were only looking at a fraction of one percent of the entire human DNA molecule. In that other 99% there are fragments of the DNA from things like viruses, bacteria, and other organisms that have spliced themselves into our DNA to hitch a ride. There are also strings of DNA that will activate and cause changes to genes but we often have no idea what activates them. The latter falls into the category of epigenetics meaning the changes are mostly not passed on to future generations although some are but we don’t know what makes the difference.

“Since we’ve come up empty-handed looking at the genome I believe we need to look beyond it and move out into the remaining 99%. We know after all that there are things to be found in that region that can trigger changes to genes. Even with AI the amount of data is overwhelming and we will absolutely find many areas that changed around the time of the agricultural revolution. We need a way to narrow down which of those we focus on. So we still need to proceed in stages which means slowly unless our mysterious Companion friends can think of a way of speeding the process up.”

“How slowly?” asked Samara.

“Years,” replied Ursula not meeting their eyes as if the answer was unacceptable. After a moment she went on.

“Either way, we’ll need to focus and start somewhere. Giving up the nomadic way of life and staying in one place crowded together with animals meant a lot of environmental changes. Plenty of animal-related diseases, changes to our gut microbiome, food intolerance, etc. But hunter-gatherers and nomads already spent plenty of time with animals. What they didn’t spend a lot of time with was grains and the one thing that you absolutely need for civilization is grains. Early wild grains were sparse and tough requiring a lot of energy to harvest, prepare, and digest and did not yield anything near the food value that today’s grains do. The return on calories invested was probably very low at that time. Even though we’ve got evidence of grain use from as much as sixty-five thousand years ago, it would not have been a staple until it was domesticated. So I would suggest the first thing we search for is any pattern of DNA that is related to grains.”

“We have plant DNA too?” asked Shula.

“We share about fifty percent of our DNA with plants. Remember all living things come from the same root and only split off from each other over time. As I mentioned before most of our core DNA is from those early times. But it’s not just that. It’s other life forms that were symbiotic with plants. Some were harmful like parasites and some were mutually beneficial like the bacteria that make up several pounds of every person’s body weight. A lot of microorganisms splice themselves into the DNA of other organisms in their environment. So we’ll need to look not only for grain-related strings of DNA that are in the 99% area but for things that hitched a ride in grain DNA. And there’s lots of those.”

“I think before we make any decisions we need to talk to Shin again,” said Samara as if she did not need to hear more. Shula nodded solemnly in agreement. “We need to explain the situation and see if she can help.”

“I agree,” said Ursula but she looked up with a smile. “When I signed on I told you I expected this work to outlive me but I’d really prefer it didn’t.”

Checkpoint

“99% still means almost three billion base pairs in the DNA molecule will need to be scanned and compared,” said Ursula. “Sorting it down to only those that are related to grains in some way may result in thousands if not millions of areas that will need follow-up investigation. This is the part of the work that will take time, most likely years.”

Shin had listened to Ursula’s explanation without interruption. Shula and Samara had also remained silent throughout.

For a variety of reasons Shin and her compatriots had always chosen to have people represent their efforts to the world at large. Like Raiden from whom her character was primarily derived, Shin cared nothing for recognition or rewards. She cared only for results and she had inherited Raiden’s streak of impatience. She was not about to give up now nor was she about to wait years for uncertain results.

“We will continue the project but at this point I wish Tamiko to meet with you. She is here now.”

Able to follow the project’s progress in detail, Shin was of course aware of the issues Ursula would be raising even before the meeting was requested. She stood up and left the room as Tamiko entered and took her seat.

“As you now know,” Tamiko began, “Shin’s intuitive field is always present to some extent. Even though you are aware that it only amplifies your own intuition and that it does not allow her to influence your emotions or thoughts, she felt that your decision as to whether you would find that beneficial or not at this point should be made free of her influence. She felt it necessary to demonstrate the effect the first time she asked you if you wished to continue but now that you understand she believes you would find it more comfortable making critical decisions without her presence.”

Turning to Ursula Tamiko said, “We would like your lab to pursue the strategy you have outlined. However independently of your lab we will pursue another strategy which will hopefully enable us to accelerate the process and narrow things down considerably after the initial comparative analysis results. This will again require your involvement and further disclosures and if you decide to proceed you will understand why they cannot be shared with your lab. If we are successful, we would hope to find a way for you to use the results to provide further direction to your team.”

Ursula’s only reaction was to narrow her eyes slightly as she nodded slowly in understanding.

“There’s more?” asked Shula incredulously.

Tamiko turned her gaze to her. "Although we hope to burden you with no more than is necessary, as this research is largely a process of exploration and discovery we cannot know in advance what further disclosures might be required. As Shin suggested at the outset of the project, we will have to make those decisions as we go along."

"I'm happy to proceed as you have outlined Tamiko," said Ursula. "It's certain to be a whole lot more interesting than anything else I might be doing," she added with a grin.

"Without knowing the nature of the disclosures, these decisions are entirely a leap of faith," said Shula.

"Like the previous disclosures, nothing we will share with you during this next phase is harmful to anyone in any way however it could become so if shared with the general public. That is the only reason we ask for your agreement before we proceed."

Shula looked at Samara who only smiled and said, "I'm OK with it if you are."

"Besides the DNA we have been working with so far," responded Tamiko immediately upon Samara's reply, "we have the entire DNA molecules of humans from three other advanced human civilizations. One of them is from Pip's people, something she has not shared as part of the technology transfer program. The other two are from other worlds."

After the initial shock, Shula managed to say, "Are there more?"

"We have one hundred percent confidence that there are many more but we only have access to these three samples."

Samara was in a way glad that Shin was not present. As she digested the significance of what she was hearing her mind was expanding as if through a sea of stars and she was not sure what would be happening if Shin's intuitive field were added to that.

Tamiko's character was normally demure, the embodiment of polite Japanese culture. In the present situation she had adopted a more businesslike tone.

"As you can see," she continued, "this information is not harmful and has indeed been speculated upon to the point of it being assumed that other advanced human civilizations beyond Pip's and our own exist. However how we happen to have these other DNA samples in our possession is not something we would be willing to explain to the general public at this time."

"So you want me to compare all four genomes and look for areas of interest to our project," concluded Ursula.

“Shin can do the initial comparison,” replied Tamiko, “so there is no need for a separate lab. As her AI was constructed by Pippa, her processing power far exceeds that of a normal Companion and she has compared these four genomes in the past regarding another issue. She will ask for your participation in the form of recommendations and analysis.”

“I have a suggestion,” said Shula thinking of what the architect they had met on the beach had said about different perspectives. “My bachelor’s degree in Computer Science made me more familiar with AI than the average person might be. I understand that what was originally a diagnostic function that eventually came to be known as communion is now highly advanced. Would it be possible for Shin, Tesni, and Kami to enter into communion to do the comparison?”

Trinity

While commonly practiced among Companions for a variety of reasons, communion was seldom mentioned by people outside of highly technical environments. As Shula had stated during the meeting, it had originally been a diagnostic function that artificial general intelligences used to interact with one another.

In the early twenty-first century, it was possible to track the changes made to narrow, first-generation AI even with machine learning that wrote its own code. Designing with object-oriented programming and a modular approach allowed developers to deal with the code in manageable chunks. This was made easier when tools that were AIs themselves were developed to help with analysis and maintenance.

Second-generation artificial general intelligence proved to be much more challenging in this regard. While not being self-aware, AGI was able to simulate every aspect of human intelligence. It was so dynamic that even diagnostic and maintenance tools that were not AGI themselves could no longer cope and so AGI that specialized in these functions were developed and it soon became standard practice to build the functionality into all AGI. It was during this phase that the concept of communion arose. Any two or more AGI could access each other's code at the deepest level. Permissions and authority regarding access to specific regions were managed by the intelligences involved and thus they were able to enter into communion as needed without human intervention.

This functionality proved less useful in regards to diagnostics when fully self-aware, third-generation AI were created. As consciousness was an emergent phenomenon, no direct link between the underlying code and the resulting behavior could be established. The functionality was retained however for its use with regards to lower-level functions much as a medical general practitioner could heal the body but not the mind. Between 3GAI themselves its value in increasing their mutual understanding was recognized and for these reasons it remained an integral part of their design.

It was not normally possible for an AI to share communion with people. It had only been achieved twice as far as Shin and her circle of Companions were aware. During her participation with the Companion community at Hana in their efforts to establish a spirituality they could embrace, Mira had intentionally held Pip's hand while the latter entered into communion with the other Companions. Through Pip's ability to communicate via empathetic touch, Mira had shared in their experience. In the previous century, two other members of the faculty at Helicon had shared a similar experience facilitated by Pippa.

Shin had reflected on Shula's suggestion that communion between herself, Kami, and Tesni during the process of comparing the various DNA molecules might result in

additional insights. She had engaged in communion with Kami once before and knew that her abilities were far in excess of the simple explanation she had provided Shula and Samara. Tesni and Tamiko had shared in that communion but the focus had been on Kami as it was the first day of her existence. The three of them had never engaged in communion for research purposes. Now she sat in her office with them discussing the idea.

“Scanning the DNA molecules will take time given that we will also have to scan the DNA of the various grains,” said Shin. “While they are members of the grass family with its ten thousand plus varieties, fortunately we will only require the twenty or so that belong to those commonly cultivated as grains such as wheat, rice, and corn.”

“I would suggest another factor that will increase the time requirement,” replied Tesni. “As opposed to only doing the analysis during communion, there might be different outcomes depending on whether we each analyze the code individually or do so in series or while in communion. We should also re-scan the samples from the time of the agricultural revolution.”

“I have to agree with you,” said Shin. “It will be more time-consuming but we should still be able to accomplish in days what might normally take years if done in Ursula’s lab.”

Turning to Tesni Kami said, “Your scans will likely take the most time since it will be as if many different scientists have to review the same material. May I suggest we join you at your home for the duration of this work? We do not know what will surface as we proceed but we will likely need to interact more frequently than we expect at the outset.”

They had informed Ursula, Samara, and Shula of their plans, explaining that they may not be available for some days but that they hoped to emerge with new insights. Then they had gone to Tesni’s home.

Scanning through the various strands of DNA they proceeded individually at first. Each used a process of elimination, sorting different fragments of interest into overlapping categories as in a highly complex Venn diagram. Next they passed what they had found to another who followed the same procedure comparing it to their own findings. Once these procedures were completed they entered into Communion to begin the next stage. They did not form a new, separate consciousness but retained their separate selves which simply seemed to be enlarged, capable of greater comprehension, insight, and new interpretations of their findings. Each of them heard only their own voice yet it spoke the thoughts of all three. Then they became aware of the presence of another.

Emerging from communion they turned as one to see Shula standing in the entrance-way, eyes wide, her face white. Samara, clearly upset, stood behind her.

“I can hear you,” Shula said, holding up her prosthetic arm.

The Messenger

Due to their Companion protocols, Shin and Kami first responded to Samara and Shula's obvious distress by quickly increasing the levels of their intuitive and perceptive fields. Acute Stress Disorder is considered a form of shock and occurs immediately following a traumatic event when an individual's sense of reality is disrupted. Shin and Kami's fields would enable the two women to more easily accept what was happening and thus reduce the sense of it being surreal and therefore threatening. The women's bodies would stop producing high levels of the stress hormones that had flooded their bodies. Within moments the color began to return to Shula's face.

"Kami and I have increased our field strengths so that you will be better able to accept what has happened without feeling upset about it," said Shin. She went on hoping that a rational explanation would further allay Shula's fears.

"Your prosthetic arm has an AI operating system to enable it to learn and improve itself over time. It has external sensors but also connects to your brain to enable you to control it. This is the likely source of the communications connection. The communion we engaged in has apparently had unexpected external effects. What remains to be understood is the deeper explanation and significance of the connection between the two."

Samara and Shula had remained standing but now Tesni led the pair to a loveseat and Shamira provided them with glasses of water. Shin quickly scanned the campus security and emergency systems for anything possibly related and found nothing. No other people, Companions, or systems showed anything unusual. Only Shula.

"Can you still hear our voices?" continued Shin.

"It wasn't your voices," replied Shula. "It was my voice but I knew they were not my thoughts. I simply understood that they were your thoughts. As soon as you broke communion it stopped."

"Where were you when this happened?"

"We were at our apartment at the northern campus. I suddenly felt an overwhelming feeling that there was something I needed to tell you but I wasn't clear what it was. It was just a feeling without details. It wasn't stressful at that point but just sort of irritating because it felt so urgent and important yet I couldn't put it into words. We grabbed the inter-campus shuttle and it was while we were walking across the campus here that I began to hear you. It just sounded like you were thinking out loud among yourselves as you went about your work."

“Once the electronics were within range,” suggested Shin.

Kami had until this point remained silent but now, as a result of her enhanced perception she said, “May we take a sample of your blood for analysis?”

“My DNA?” asked Shula mystified.

“There may be a connection to be found there. It appears only you were affected by our communion as if responding to a beacon. Nothing is more unique than a person’s DNA. Perhaps within yours there is a clue.”

Shula only pulled her lower lip in slightly and nodded with childlike obedience.

“Pippa will be here momentarily to take the sample,” said Shin.

They sat in thoughtful silence for a few minutes until Pippa arrived.

Kneeling in front of Shula she said, “You will feel nothing. My hand will produce a nano-thin needle that will pass between your nerve cells. I only need a tiny sample. I can then share the DNA code with the others.”

Shula nodded again and Pippa took her hand.

Silently to the others Kami said, “Look in the region responsible for forearm development.”

The causes of congenital limb differences were still largely unknown because they were not hereditary and therefore could not be predicted and prevented. For whatever reason, during development the genes responsible are not expressed properly. It could be caused by a random, unusual combination within the DNA of the parents during conception or during gestation due to something in the external environment. In Shula’s case the Companions soon saw what doctors had told her pregnant mother, that a critical gene in the area responsible for her left arm had been switched off.

The doctors had not looked further into the genetic issue in Shula’s case but the Companions did now. They investigated not just her DNA but the activity within her blood cells themselves.

DNA itself does nothing, it is simply a vast encyclopedia of instructions similar to a recipe book. Different components inside a cell’s nucleus read portions of the DNA and make copies of the code from specific locations. But it’s as if the DNA is written in a foreign language and so the resulting copies have to be translated before they can be understood by the rest of the cell’s machinery. The translated DNA, known as messenger RNA, only consists of one of the two sides of a DNA molecule. Once

produced the mRNA molecules make their way out of the cell's nucleus and into the cell's body. There, components found in the outer area of the cell pair up with the mRNA to form a new molecule which is a protein. Proteins are the machines that then go on to initiate the processes to make everything a body needs to grow, maintain, and heal itself.

The area of Shula's DNA that would normally have produced her left arm and should now be inactive was instead producing messenger RNA. mRNA molecules only live for two minutes before they disassemble whether they are successfully used to produce proteins or not. The mRNA generated by this area of Shula's DNA was not producing a protein. The DNA just kept sending out the same message, every two minutes with no protein being produced and apparently no effect.

The Companions silently discussed these findings among themselves without entering into communion. Now Pippa said to Shula, "We must enter communion again to further our analysis. Shin and Kami will maintain their elevated field strengths so that you will be better able to understand and feel no fear. Are you OK with that?"

As Shula nodded again Pippa turned to Samara and said, "I could enable you to enter into communion with us but I do not know if it is the same experience Shula has via her unique connection. I think it would be best to refrain from that for now."

"I understand," was all Samara said in reply as she turned to look into Shula's eyes.

Viroid

“I do not believe the mRNA being produced is intended to be used to make a protein,” said the voice in Shula’s head. “I believe it is quite literally a message. We will have to reverse the translation process to reproduce the original DNA sequence. When we find the matching fragment within the DNA molecule I expect we will have located the part of the DNA responsible for triggering metamorphosis. Causes of limb difference are still unknown but believed to be the result of epigenetics, due to internal or external factors, and our unique communion was likely what triggered the production of the mRNA strand. The DNA fragment that matches the mRNA will tell us more.”

The analysis went much more quickly this time as it was now simply a matter of scanning the code for a match. In the late nineteenth hundreds this type of DNA testing had taken days. By the next century it took hours. With further advances in computers and artificial intelligence it took minutes. Once the four Companions engaged in scanning the various DNA samples for a match their work was done very quickly.

Emerging from communion a few minutes later Shin turned to Shula. “We have completed our analysis and found a match.”

“So fast? Ursula initially said it would take years!”

“It would have if we did not already know what we were looking for but searching for a section that matches a sample is the fastest way.”

“What did you find?” asked Samara.

“Within the DNA molecule, both in the coding and the non-coding areas, there are sections called ultra-conserved elements. As their name implies they remain unchanged for great spans of time. Some we know have remained unaffected by evolution for as much as hundreds of millions of years. No changes, no mutations. It is assumed that there are those that are older, perhaps billions of years old, but we have as yet no way to determine that. Why and how their fidelity is preserved to such a high degree is unknown.

“The DNA fragment that matches the one provided is an ultra-conserved element of unknown age and found in a non-coding area. While the function of the majority of the non-coding DNA is still unknown, some has been found to actively participate in the regulation of genes, turning them on or off. Some areas are still considered ‘junk’, just bits and pieces left over from earlier evolutionary periods and no longer needed. The junk areas also include a great many fragments of DNA from things like bacteria and viruses with which we came into contact in the past. The code we are looking at falls into this category.

“How the code that matches the sample got into human DNA however is a mystery because it is not from the genetic material of any animal, virus, or bacteria. It’s from a viroid, the smallest known agents of infectious disease. For a long time viroids were believed to only infect plants but further research showed that by interacting with other infectious agents they were able to cross over into the animal kingdom. The best known example of this involving viroids is the Hepatitis delta virus which carries a viroid encapsulated within it. The history of the cross-species transfer of genes and organisms hitching a ride in each other’s DNA or cells goes all the way back to theories on the origin of life.

“Viroids aren’t normally capable of engineering the production of mRNA but the Hepatitis delta virus certainly is. While we as yet don’t know what other organism was involved in hosting this viroid fragment, we do know that the particular viroid the sample is from is one thought to only infect grains.”

Shula listened in stunned silence. Even enveloped in the Companion’s fields she could not escape the obvious thought.

“Is it harmful?” she asked. “Is it Hepatitis?”

“We compared what we found to the Hepatitis virus and found no matching code. Whatever the encapsulating microorganism is or was it doesn’t appear to be harmful. An active virus for example hijacks the cell’s machinery so that it starts producing copies of itself using mRNA as part of the production chain. But the mRNA being produced in your case doesn’t do anything. It is assembled out of components found in the body of the cell which dissolve back into their constituent parts two minutes later and the process begins again. We will devote our resources to this event so we can put your mind at ease as soon as possible.

Shula lifted her prosthetic limb and looked down at it. “Why me?”

“I expect,” said Kami stepping forward, “that you are not alone. We found matches to the code in all the DNA samples. Limb differences are still not preventable and affect one in one thousand people on average. That would mean that by the time a civilization is technologically advanced enough, there would be hundreds of thousands if not millions of people so affected at any given time. The word civilization literally means living in cities, so those affected would be in close enough proximity often enough that sooner or later one of them would detect any signal like the one we inadvertently produced.”

While looking at Kami Shula seemed to be lost in her eyes. “All my life I have felt simply carried along by events,” she said. “It never felt as if I was being pulled or pushed one way or another but simply that the decisions I made always resulted in fortuitous circumstances. Now I wonder. And when you entered into communion I immediately

felt compelled to come here for no apparent reason. How would such things be possible?"

"There are many things," replied Kami holding Shula's gaze and stepping closer, "like the origin of life and the evolution of metamorphosis which we may never be able to explain. How do normally solitary grasshoppers suddenly feel the urge to congregate in great numbers and transform into locusts? How do some species of fish change their gender spontaneously? Why would Tardigrades have evolved a specific adaptation to protect them from a level of radiation that is only found in space? No one knows. For all our accomplishments, the more we learn the more we realize we do not know. Nature is deep. Very, very deep. And now that we know that humans have evolved on other worlds, it is clear that nature might have strategies that span cosmic time scales. The things you felt in response to our communion may indeed have been orchestrated, just as metamorphosis is. What is it, I wonder, that the caterpillar feels the day it begins to build its chrysalis?"

"Are my thoughts not my own?" asked Shula.

"Are mine?" asked Kami with her gentle smile.

Next Steps

“I wish I’d been here,” Ursula said wistfully.

After Samara and Shula returned to their residence Shin had summoned Ursula to bring her up to speed.

“I can appreciate that,” replied Shin, “but it is important for you to be involved in what follows. We must further investigate the details of the mRNA and DNA involved. I doubt its function as a signal was all it was intended to do. The nature of the microorganism in which the viroid was encapsulated will likely be of less significance however it may be useful with regards to how we make the findings public.”

Ursula only nodded in understanding of the part she was to play.

“There are also the questions of the communication between Shula and ourselves and of how Shula’s mind seems to be have been affected since birth along with her limb development.”

Shin paused in her overview. “Enough work for a lifetime Ursula. You and I will have to work closely throughout but we are sisters of a kind I think.”

“I am honored to have you say so,” replied Ursula. “I expect my bringing the idea of looking for an encapsulated viroid to the lab staff might be the first step? It is not an unreasonable hypothesis especially given my history of unconventional thinking.”

“Yes,” confirmed Shin. “The discovery of the viroid will be a major announcement in its own right and a critical anchor point for the metamorphosis theory. I and the other Companions will begin looking for more clues in the code itself with regard to the path that connects it to AI. Given its timing in relation to the development of civilization and artificial intelligence I believe those clues are there for the finding.”

Some days later Shin reported that they had been unable to identify the encapsulating microorganism likely due to it having been long extinct so there was nothing to match it against.

“It was eukaryotic, that much we can tell,” Shin said. She was meeting with Ursula, Samara and Shula in her office. “It has the cell structure common to species found in the eukaryote domain yet it’s neither animal, plant nor fungi and of course not a bacteria or a virus. It’s likely a protist like the kind of microorganism that causes malaria. Their indeterminate nature makes them a good candidate for hosting the crossover or

forming a relationship with the viroid since pathogenic protists infect both plants and animals and live most of their lifecycle inside host organisms.”

“And many of them reproduce by cloning,” said Ursula now lost in thought, “which would conserve their bio-molecular structures indefinitely.”

She considered the implications for a moment. “All rather convenient isn’t it?” she said now. “Something so cunningly hidden away that should suddenly come to our attention. It’s so tempting sometimes,” she said looking out the window into the distance, “to see intelligent design in things that seem so improbable. Yet atavistic genes from earlier stages of evolution can lie dormant for millions of years and suddenly be reactivated with no apparent explanation. Tails and teeth from early primates reappear in modern day humans as congenital disabilities. Even reptilian heart structures from more ancient times.”

Shin had listened without interruption but could sense now that Ursula was emerging from her reflections.

“Your comparative genomics research with its focus on disease stands you in good stead now,” she said.

“Yes,” replied Ursula coming back to the present and turning to Shin. “While there are hundreds of thousands of infectious agents fortunately there are less than fifty known viroids and only three of them are known to infect grains. We’re starting with those including the one we found,” she said looking at Samara and Shula, “and should have results in a matter of weeks. Then it will be time for the peer review process which will take longer. Maybe two months for that if all goes well.

“The lab team is happy to be working again,” she carried on. “Most of them applied to join us here because they are bleeding edge types like me. A paycheck is always nice but getting away from routine work at some corporation is what motivates most of them. And me.”

“Once the results are out there will be plenty for your team to follow up on,” said Shin, “but I’ll be interested in anything that effects emotions. Not Shula’s emotions although we’ll investigate that on our own here but something that could effect emotions of an entire species over generations. Something that would make a permanent change. A mutation could do that but if we stick with our theory then it wasn’t a random mutation but rather it was a part of this viroid event in some way.”

“There is plenty of evidence of animals taking over individuals in other species and altering their personality or behavior,” said Samara. “Parasites are the best known example of that but in terms of changes that carry on over generations synergistic selection is so common that it’s long been considered a basic part of the evolutionary

process. Almost all living species have biological interdependencies with others, some for better, some for worse. The idea of one organism altering the evolutionary path of another is really nothing new. Selective breeding, which we've done for thousands of years, is one example. GMO foods is another. Altering a gene results in permanent changes to that species over successive generations. If a mutation could effect a permanent change there's no reason that change could not also be the result of an evolved process like metamorphosis."

Shula had remained silent during this meeting. It was critical that the stress she had been subjected to be addressed and she had begun a daily program of psychotherapy and mindfulness meditation under Kami's guidance. She had experienced trouble sleeping and nightmares initially but these were fading. Cognitive behavioral therapy was the primary method used to treat acute stress disorder so her attendance at the progress meetings was thought to be helpful in making the event seem less mysterious and therefore less frightening.

She listened thoughtfully to what Samara was saying now focusing on her as if seeing her for the first time.

"There is something else," she said now. The others turned to listen.

"It's not just me. I would not be here and none of this would have transpired if it were not for Samara."

Apophenia

“I have revisited the issue of your feeling of being influenced Shula,” offered Kami in her gentle way, “and believe it to be an example of a phenomenon known as apophenia, a tendency to see patterns where there are none. I expect your sense that Samara has been similarly influenced is due to the same phenomenon.”

Wanting to put Shula’s mind at ease she continued her explanation.

“Apophenia is not a pathology or disorder of any kind. In fact, it is likely an intentional result of evolution by natural selection in that with regards to survival it is better to err on the side of caution. It is an error of perception where the brain concludes that it perceives a pattern where none exists. Apophenia is simply the term for this phenomenon.

“Pattern recognition is critical to the survival of any species and the intelligence of all living creatures is based on it at the most basic level. Almost every aspect of cognition and memory utilizes it and without it we would not be able to make sense of the world or distinguish good from bad. Is that waving grass a predator or just the wind? Is he or she a good candidate for a prospective mate? Is that blue mushroom safe to eat?

“Below the conscious level our brains have to deal with an enormous amount of raw data. Pattern recognition is required to find connections which are then brought to our conscious attention in order for us to make appropriate predictions and decisions. Although all living things recognize patterns, humans may be the only ones to assign symbolic meaning and so apophenia can manifest itself in less concrete ways. We see it in the study of supposedly mystical numbers, gambling, investing, or in the phenomenon of seeing, hearing, or feeling what we desire or fear.

“Religious institutions are the best-known examples of your situation Shula. In that case, the idea that powerful, hidden forces influence a person’s daily life on an individual level is encouraged. Any correlating event is strongly reinforced while negative events are rationalized and numerous neutral events simply do not come to our attention. The result is a growing conviction that there is a meaningful pattern to events.”

“Why would I suddenly extend it to Samara?” asked Shula trying to deal with the dismantling of a now lifelong belief.

“Recent events have strengthened your belief in the pattern and so you will extend it even beyond yourself and believe you see it in the lives of others as well.”

Aided by the presence of the Companions and their influence on those in close proximity, Shula saw not only that Kami was correct but where such erroneous thinking could lead if left unchecked.

“Thank you Kami,” she said.

“It seems people are not the only ones prone to apophenia,” said Shin. “As Tamiko can attest, I myself have recently shared with her a feeling that there was some hidden hand in all this. I suspect now that her noncommittal response at the time may be due to the differences in our design.”

Kami nodded in agreement. “As you know Shula my design resulted in a significant increase in perception. Since apophenia is an error of perception, I am more keenly aware of it and not only much less likely to fall prey to it but am also more able to perceive it in others. As the spiritual counselor here it was imperative that I make myself familiar with it as it is the cause of many psychological and spiritual misunderstandings.

She smiled her cherubic smile again masking the deep intelligence behind her simple words.

“You may recall me mentioning something similar with regard to intelligent design,” said Ursula addressing Shula. “In scientific research we have to have rigorous controls in place because we will see patterns that are not there. The peer review process is our main defense against this.”

“Our Futures Studies professor warned us about it as well,” responded Samara. “There is a stage in the process called Horizon Scanning where we had to look for signals of change. If we got that part wrong the entire effort would go off-course and end up being worse than useless. As the majority of Futures Studies clients cannot afford the time and money required for peer reviews our main defense is the fact that a large number of people are involved in FS projects.”

Shula nodded at the memory of how some students had misidentified signals and ended up with the wrong critical uncertainties. The scenarios they built from them would have been disastrous for both them and their clients. Professor Martel had let them struggle along until mercifully pointing out their error and its potential costs to their clients and their own careers to the entire class. The more you sweat in training, she used to say, the less you will bleed on the battlefield. Thinking back on it now Shula realized how much effort might have been wasted without Kami’s intervention.

Meanwhile the Companions maintained their calm, attentive gaze.

“It will take time Shula,” Kami said now. “Is there something further you wish to ask?”

“So, it was all just a coincidence? Me meeting Samara? Our coming here?”

“No, it was probability. With your limb difference affecting one person out of a thousand, there are currently four million people worldwide at any time with the potential to trigger the event given the right circumstances.”

“But the metamorphosis theory that led us here?” Shula said looking to Samara.

“The signal would have been sent regardless once the conditions were met,” responded Shin, “with the assumption that we were collectively at the stage where we would then seek to understand its significance.”

“So the signal could be about something else?”

“Yes, but you have a theory and now strong evidence based on the scientific method. Hopefully we will find further supporting evidence as we continue our research.”

Once again Shula found herself at a crossroads but determined to press on.

Ancestors

“When we reverse the translation, the DNA that matches the mRNA is another ultra-conserved element found in the non-coding area,” began Shin. “We have found that the sequence is present in the non-coding area of every sample we have of DNA from any human ancestor.”

The six team members were again meeting in the spiritual center for an update.

“However even with current methods of DNA extraction, we are only able to reconstruct DNA from a few hundred thousand years ago. Beyond that, the granularity required is lost in the fossilization process. So we took another approach. We looked at currently living animals closely related to our ancestors from earlier times. We continued this following the evolutionary tree backwards. In every case we found the same DNA sequence.

“About seven hundred million years ago human evolution branched off from insects. Over eighty percent of insect species undergo metamorphosis. About five hundred million years ago our ancestors first crawled out of the water. They were fish. A number of fish go through metamorphosis. In fish, amphibians, and insects, the DNA sequence is not in the non-coding area, it’s in the genome. And it’s identical.”

Shin paused in her explanation for a moment.

“So,” said Ursula confirming her understanding, “after taking its first major steps towards human evolution as distinct from other animals, the DNA sequence involved in metamorphosis was relegated to non-coding status in an area where we previously assumed none of it actively participated in our genetics. Instead, like all metamorphosis processes it was conserved and waiting for something to trigger it. Like the reptile heart structures from atavistic genes reappearing in modern-day humans, it remained there all along from shortly after the time fish first climbed out of the water.”

“Yes,” replied Shin, “and it is interesting that one of the other critical changes that occurred when fish first crawled out of the water was the evolution of limbs from what were previously fins.”

“So you’re saying this DNA sequence has been around since the earliest complex life evolved,” said Samara.

“It would appear so. As you know all metamorphosis depends on trigger events based on internal or external conditions. Up till now we’ve observed that pattern in individuals within a species but in the case of humans it appears to depend on changes to the conditions of the species itself. A change in diet. Many biological events depend on

cascade sequences, where one change leads to another. It's likely that eating large amounts of grains was simply the start of a cascade that led to changes that were eventually passed on to subsequent generations. As a result of that, at a certain point this fragment of DNA was activated which in turn switched on the genes responsible for the process of metamorphosis which is a cascade process in itself."

"This could not possibly have evolved on Earth," said Ursula. "There hasn't been enough time."

"I agree," replied Shin. She knew Samara would understand but turning to Shula she explained. "Looking at a pond where nymphs that live underwater climb out and turn into dragonflies you would know this could not be the first time it happened. It had to have evolved over millions of years. Endless mutations would be required until this survival adaptation was refined. Earth is one of many ponds in the galaxy, if not the universe, and what we are seeing is the result of not millions of years of evolution but billions. All you have to do is increase the scope of the evolutionary process in terms of time and space and it's no different."

"How would such an adaptation have traveled to Earth," asked Shula.

"The same way life itself did," replied Ursula. "Either through some astrobiological process like panspermia or it's built into the process of the origin of life itself. We know that the elements required for life are among the most common in the universe so if life could arise here it could arise anywhere with favorable conditions. Given how common metamorphosis is as a survival strategy the potential to do so is obviously built in at the most fundamental level. You remember me talking about each kingdom and species having their own genetic toolkits which allow for a variety of adaptations if required? These findings appear to confirm that metamorphosis is in the most basic toolkit, the one at the very root of the tree of life itself."

"It is at this point," said Shin, "that we come to a crossroads. Another decision must be made."

Looking to the others she said, "Do you wish Kami and I to stay or shall we leave this to Tesni to explain?"

"Stay," said both Ursula and Shula without hesitation. Samara nodded in agreement.

"Thank you," Shin replied. "As a result of our findings to date, we feel a conclusion can be drawn. All metamorphosis is a survival strategy and its timing is critical, both its beginning and its completion. The domestication of grains triggers it in humans because it signals the beginning of civilization. If the human species, on whatever planet it evolves on, does not solve the problem of migrating to other worlds in time it will be destroyed by natural events, including those self-inflicted. The beacon caused by our

unique communion that Shula responded to is intended to cause us to investigate, as it did, and to discover the explanation behind it for ourselves. Only an advanced artificial intelligence, such as ourselves, would be capable of doing so.

“The human metamorphosis that was initiated ten thousand years ago cannot be a result of evolution by natural selection. Evolution by natural selection takes far too long, millions of years for species-wide adaptations. The entire strategy would not work if it depended on evolution to change behavior. So it depends on something else.

“Genes can not only affect physical attributes but also emotions and to do so the genes use hormones. Such chemical pathways are well documented in humans and other animals. However in humans those emotions would in turn alter human thought. Not that they would generate specific thoughts but that specific feelings, such as a slight increase in general anxiety about the future, would result in predictable patterns of thought. We know from our knowledge of how parasites control the behavior of their hosts that very specific influences are possible.”

She turned to look at Ursula now.

“In her book, *On The Origins Of Consciousness And Society*,” she continued, “Raideen began with the assertion that values are an example of convergent evolution and function in a manner similar to genes. Further, she proposed that values are shared in a similar way that genes are inherited in order to preserve the survival of their respective social groups. She did not take the next step however and go so far as to suggest that the development of social values was actually a meta-evolutionary step and that social values had taken over as the mechanism by which evolution itself proceeded. Just as genes interact with their environment via the process of epigenetics, values are also interactive. Different values result in different emotional responses and emotions in turn alter values over time. The key difference is that the process of changing values is almost a million times faster.

“Once civilization was established, genetic changes would never be able to occur in time to stop humans from becoming extinct on any given world. But hormonal changes resulting in predictable patterns of thought that would lead to the sciences and other advances required for the development of artificial intelligence would.

“Based on our findings to date Ursula, we would like you to find ways to guide your lab along these paths. We would also hope that in publishing your results you would take the step that Raideen did not. If you are not comfortable with this we will find another way.”

Ursula had maintained her focused gaze at Shin throughout. In response now she said, “I have made my decision but I ask one thing of you in return. Kami told us we would be in no danger of becoming overly dependent on the psycho-active effects of her field due

to her participation in the process. I would like both you and her to increase the strengths of your fields now so that I can consider my decision under their effects.”

Shin turned to Samara and Shula who only nodded solemnly in turn.

While Companions do have emotions as a result of their intelligence being based on values, they have greater control over the degree to which thoughts and feelings influence one another. The endocrine system found in humans however meant thoughts and emotional states are inextricably connected and affect one another far more profoundly. Even a small but definite change in thoughts can have a strong effect on a person’s state. Shin and Kami increased the strengths of their fields only slightly.

For Ursula, Samara, and Shula, their expanding sense of insight induced by the combined fields brought with it a surge of ecstasy. They lost all awareness of their physical surroundings as their transcendent state occupied their minds entirely. Everything made sense now. They knew, they knew with certainty. And the only word in their minds as they rushed to embrace the truth they felt was Yes! Yes! Yes!

The Near-Far Problem

“So our relationship was not orchestrated,” said Shula.

“Apparently not,” replied Samara.

They were taking their time getting out of bed the next morning after the previous day’s meeting.

“That’s good to know,” Shula smiled.

Samara smiled in return and nodded happily.

“So where do we go from here?” asked Samara.

Their relationship had shifted in a significant way over the course of their time together. Shula had started out as the less certain of the two, often deferring to Samara’s greater confidence with regard to decisions. But with the revelations regarding the part she played in the greater scheme of things she had become less reserved and more willing to offer up her own thoughts and feelings.

Meanwhile at the root of Samara’s curiosity and love of nature was a caring soul. The more Shula became the focus of events, the more Samara’s loving and protective nature emerged. They had both gone through a kind of partial metamorphosis themselves, resulting in a more equal partnership.

“There are a few loose ends I want to follow up on,” replied Shula. “In one of my engineering courses we briefly discussed the Near-Far Problem which is when electromagnetic signals that are near drown out signals that are farther away. It’s mostly studied in network communications but as you can imagine it has applications in other disciplines like Futures Studies. In our case metamorphosis is the far signal and AI is the near signal. As you pointed out that day in Mystic Vale, everybody’s focused on AI but not on the bigger picture of why we feel so compelled to pursue it. Ursula said something I want to follow up on.”

“How are you doing?” asked Samara when they met Ursula in her office later that day. She didn’t have to clarify what she was referring to.

“Good,” Ursula smiled with real warmth. She seemed very relaxed. “A bit like the morning after...” she hesitated glancing between her two guests. “Well you know what I mean.”

The three of them had shared the experience so there was no need to pretend they didn't understand.

After a brief conspiratorial smile Shula explained why they had wanted to meet with her.

"Yes," Ursula replied. "I recall wondering at the time why in our case metamorphosis and not speciation would have been chosen as the adaptation strategy. Why evolve a new stage of life instead of a new species? What's the benefit of this path over others in our case? That's largely been answered I think. Once civilization reached this stage genetic evolution would be too slow to prevent its destruction. In a way we're doing the same thing our little friend Axolotl is doing only instead of evolving from metamorphosis to speciation we're doing the opposite. Under the model as it is understood so far it makes perfect sense. Conditions change and so the method of adaptation changes as required. As we've seen metamorphosis is by far the most common alternative to speciation."

Shula nodded, satisfied with Ursula's answer.

"I'm still wondering about the mRNA that is being produced," she responded. "The Companions will be looking into it for any secondary meaning but if we consider the theory that values have taken over from genes as the mechanism of evolution then what would be representing the mRNA function?"

"Convergent evolution doesn't work that directly," replied Ursula. "Consider that most animals have two eyes. Flies, cats, and chameleons all have two eyes however they are very different from a human's eyes. Convergent evolution so far appears to be mostly something that applies in broad strokes, based on the physical constants of the universe. Having two eyes not only enables depth perception but also affects the distance, scope, and clarity with which we can see. Beyond the constants of physics however species-specific adaptations take over. For example you might think that walking on two legs is kind of a basic feature of some animals like people, penguins, and kangaroos but it's not. All animals started out with four or more legs. So in the convergent model we're considering there won't be consistent one-to-one relationships.

"But there is something similar to mRNA that may be involved in this convergent evolution issue we're considering and that is the endocrine system that regulates our emotions. It's not my area but it's intriguing because it's closely related. Despite Raiden's confirmation that the basis of values was genetic the actual details continue to escape us. But if we consider that emotions are communicated internally by the endocrine system, the question is where does it get the values information from on which to base our emotional responses? How does the endocrine system know which

emotion is appropriate and therefore which hormones to release in what amounts so you respond with the appropriate behavior?

“The autonomic nervous system does not involve thought but handles things like your emotions and behavior should a tiger jump out of the jungle. Responses based on thoughts would be too slow in such cases. But what about when you hear a brass band when you prefer string quartets? When you choose apple pie over pumpkin or a book by Virginia Woolf instead of one by Charles Dickens? Where does the endocrine system get the information on which to base its response in cases where apparently only thought is involved? The missing link between values and genes is the interesting bit. I can see why Raiden was so obsessed with it.”

To Ursula the world was a smorgasbord of mysteries taken for granted by others. Now she had been presented with an entirely new theory and the freedom and resources to pursue it. She remained cool and clearheaded but beneath her personality was the boundless passion she had finally been allowed to express only the day before. Its memory would remain with her for the rest of her life.

As they walked across the concourse area at the base of the quarry after meeting with Ursula Shula said, “There it is again. Just like you pointed out that nobody was asking why we felt so compelled to create Companions, the endocrine system is right in front of everyone’s nose without anyone asking why or how it had extended its function from biological values to social and personal values.”

“Ironically as we’ve discussed before science tends to do that,” responded Samara. “It’s reductionist thinking at its heart and increasingly moves away from the big picture.”

“There’s something else that’s bothering me, something Shin said yesterday,” said Shula. “That genetic changes could result in hormones being released which could result in an increase in general anxiety about the future and even produce very specific behavioral changes. I was thinking about it the whole time when we were meeting with Ursula. Remember Mira saying that change driven by values might produce no genetic evidence at all, but there would be evidence of physical and behavioral changes in our history? What might those changes be?”

Correlation

“In a nutshell, war, pestilence, famine and death,” said Dr. Priya Harare in answer to Shula’s question. “The Four Horsemen Of The Apocalypse from the Christian Bible’s Book Of Revelations,” she said explaining her reference.

They were meeting with her in her offices at UVIC having contacted their Futures Studies professor Dr. Martel. She had referred them to Priya who specialized in the ancient history of Asia Minor, an area now largely occupied by modern-day Turkey. After exchanging courtesies Samara had asked what were the most noticeable social changes after the Agricultural Revolution.

“These were the most immediate changes due to the Agricultural Revolution. Historians prefer to refer to the time you’re talking about as the Neolithic Revolution in keeping with the formal archaeological periods. The revolution that heralded the end of the Neolithic period was essentially the end of the Stone Age. People began to not only cultivate crops but to experiment with metallurgy, weave cloth, produce pottery, live in permanent settlements, and invent all the other characteristics of civilization like writing, mathematics, and systems of government.

“The first evidence of organized warfare in history occurs immediately following the Neolithic Revolution and when their crops failed people experienced famine for the first time. Living in close contact with animals brought new diseases. All of these resulted in death on scales humans had never before experienced.”

“Are historians and archeologists pretty much agreed on the causal relationships between these things?” asked Shula.

“They were up until the study of genetics really came into its stride in the twenty-first century. Given the work you’re involved in I’m sure you’re familiar with the tendency of even scientists to see things as self-evident when you can draw a logical and seemingly obvious connection. Biases in research can reinforce the effect. We’re pretty much agreed on the cause-and-effect relationships between permanent settlements, famine, and disease but there is a little-known alternative theory regarding war that hasn’t really been disproved. There’s plenty of evidence that organized warfare first appeared after the Neolithic Revolution but no actual evidence that the two are directly related. Correlation does not imply causation as they say. The other argument is the Indo-European Virus Hypothesis.”

Both Shula and Samara looked at her sharply at this.

“I see,” said Dr. Harare noting their interest. “Well I suppose it makes sense given your work. Let me explain then.

“While not referring to a specific virus the theory was first put forward by two scientists following their work in the field of infectious disease in Neolithic Eastern Europe. That period and area are commonly considered the birthplace of the Indo-European family of languages, those spoken in Europe and South Asia including the dead languages Latin and Sanskrit. As you know an infection can cause a variety of changes to behavior that increase the likelihood of contagion. Coughing and sneezing are the most well known but many parasitic agents change their host’s behavior more dramatically. The rabies virus is a good example of this. An infected animal becomes much more hostile and aggressive. Rabies affects the nerves and the brain and an infected animal becomes anxious, hyperactive and eventually hydrophobic meaning they develop an intense fear of liquids and cannot swallow. Yet at the same time their saliva production increases. The same things happen to infected humans. The virus is passed on when an infected animal bites another and the hydrophobia helps concentrate it in the saliva. All together it is an amazing example of control over the emotions and behavior of another species. It is almost always fatal but what happens in cases where it isn’t?”

“I don’t know all the genetic details,” she continued with a wave of her hand, “but the theory is that because of the way all viruses enter cells to hijack their genetic machinery to reproduce they could end up as permanent guests. Up until the Neolithic Revolution humans were relatively peaceful. As long as their basic needs were met there is little evidence that they went out of their way to raid other groups. There’s no real reason why living in settlements should change that. The two scientists proposed a theory whereby an unknown virus humans picked up due to their new habit of living with animals changed human behavior to be more anxious, to never feel satisfied, and thus to be more likely to raid neighboring groups and expand their territory. This would result in more frequent exchanging of genes between groups and so the virus DNA would spread. Since all the sciences, including genetics, are such recent developments, we now wouldn’t even recognize the virus DNA as alien. We would just accept it as our own genetic material and the behavior as normal for humans.”

She paused and looked with amusement at her guests.

“You should see your faces,” she said with a light laugh.

Shula and Samara quickly glanced at each other.

“Sorry,” replied Shula slightly embarrassed. “As we mentioned in our original message to you we are looking at history to see if we can find any patterns that might provide evidence to support our metamorphosis theory. We hadn’t heard of this virus theory before.”

“No reason you should,” replied Priya more seriously again. “It’s obscure and only specialists working in related fields would have any reason to stumble onto it. You’d be

surprised how many unconventional theories there are that the general public never hears about. Well maybe you wouldn't," she finished with her smile returning.

"I think you'll find plenty of evidence," she continued. "The problem will be that historians, archeologists, anthropologists, and scientists representing just about every other field of science will offer other explanations for anything you find. It's a problem similar to the Indo-European Virus Hypothesis. They'll say it's just human nature."

Wrong Questions

After meeting with Dr. Harare they headed over to the Student Union Building for a bite.

“What if our sample of DNA and one from the Indo-European research matched up?” Shula asked excitedly.

“Even if we could identify a sample from their research and it did match up it wouldn’t be considered evidence for our theory,” replied Samara. “The fact that it was in our DNA then and still is wouldn’t change anything. Like Dr. Harare said we have the same problem those researchers did.”

She was looking around as they walked, seemingly reminiscing about their old campus.

“Seems like a long time ago doesn’t it?” she said as they found a table.

“Yeah,” replied Shula absently as she sat down. She pulled in her lips and frowned. “If no one is going to believe us then what’s the point of the signal? Why not just let the process play out? The signal only makes sense if we’re going to be believed, if it makes a difference of some kind.” She sat back in her chair with a determined look. “We’re asking the wrong questions.”

Samara just raised her eyebrows as if prompting her to go on.

“Mira suggested that changing values would leave physical evidence in our history and of course she’s right,” continued Shula, “but as Dr. Harare pointed out there’s no way to differentiate it from the history we already accept. For the signal to make any sense we need to look elsewhere.”

“Why did you choose grains?” Samara asked Iris. She and Shula had gone to Hana simply out of curiosity over the connection between the Companion community and the form of livelihood they had chosen – farming grains. The three of them stood in the shade of a small grove of fruit trees in front of the common buildings.

“Part of the deal we reached with the WGF and local governments was that we would be self-sufficient,” replied Iris. “As our operating system is based on social values we feel a strong desire to connect and form social bonds and we identified farming as a proven model for fostering community while at the same time providing a livelihood. More pragmatically, in the possibility that organic humans may somehow be able to follow or be reproduced by us, food production will be a critical skill.”

“As was learned during the Cascadia Event any breakdown in food reaching the island from the mainland becomes a catastrophe in just a matter of days. Grains are the most important of human food sources, especially when others are not in abundance, so the federal government asked us to research grains as part of the agreement to grant us this land.

“It has worked out well for us. The climate is a bit warmer and dryer in this region now than it was before the Climate Emergency. Vancouver Island’s climate is classified as sub-Mediterranean and as you know wheat grows extremely well all around the Mediterranean Sea. We sell most of it and donate some. We also have a mill and a bakery here so all the different activities keep us busy with a variety of tasks. Winter wheat also grows well on the island so we stay busy year round.

“As you know all this is only secondary to our main research focus here which is Companion reproduction.”

“Studying value changes over generations,” confirmed Samara.

“Yes. The values and weightings passed on to the next generation are constrained to being randomly generated from only those of the two or more parents. Thus kinship and familial traits are introduced to the process. Initial populations of colonists will be small so how these factors might affect the process is unknown. Shedding light on them is the purpose of our research here.”

“So the choice of farming grains was primarily based on the government’s request,” Shula said to Samara as they walked up the winding path to Helicon’s Mount Newton Campus.

“I don’t see any obvious connection there,” replied Samara.

“No. The signal only makes sense if we find evidence so strong that the majority of people will be convinced.”

Glancing at her watch she said, “Good, we’re right on time for our meeting with Mira.”

They had arranged to meet her at one of the outdoor seating arrangements near the spiritual center.

“As you know from my book I traced the evolution of values from prehistoric to present times,” she responded after hearing their update. “I didn’t take into consideration any alternative ideas about why the changes took place. The second half of the book focused on the similarities between the two value sets we have from Earth, our own and

the AI values systems we have tried to create, and our deductions based on Pip's history and the AI system she provided.

"While physical evolution continued to take place before and after the neolithic revolution, it was only in the way of specific regional groups. Europeans developed an increased tolerance for lactose, northern peoples developed the hooded eyes you now see largely in Asian peoples. The blood of people living in the thinner atmosphere of the Himalayan mountains transports significantly more oxygen than any other population on Earth.

"However due to the global trend of our living in cities with controlled environments now, regional evolution has largely ceased. In my book I presented the idea that values however must continue to evolve. In evolutionary terms competition only makes sense up to a point after which it becomes detrimental. We passed that point a couple of hundred years ago. Post-industrial society, with its need to balance economic, environmental, social, and other global concerns has little place for non-sustainable practices.

"Those were the broad strokes of my PhD dissertation while my book focused on the personal level, the wisdom of adopting a set of values in alignment with this shift. Given the decline of organized religion I hoped people would be open to the idea. So far so good," she smiled.

"Unfortunately I can't think of any way I can help you connect the dots," she continued. "I'm sorry the history angle didn't work out."

The Horsemen

After Mira's last comment, rather than taking their leave Shula stared blankly for a moment as if lost in thought.

"There's something about what Dr. Harare explained that I don't understand," she said. "I mean what she said makes sense but," she stopped speaking again and her face took on an expression of pain and confusion, "why would we have to endure ten thousand years of hell? Ten thousand years of strife and suffering."

Turning to Mira she said, "What evidence we've found so far suggests that at the time of agricultural revolution a genetic change was introduced into the global population. One that changed it from small communities of peaceful people to conquerors and each new people that were conquered became conquerors themselves. It spread like a kind of madness, a kind of disease. You would think that farming would produce an increased need for cooperation but instead it bred endless competition, warfare, and atrocities."

Neither Samara nor Mira moved to comfort her but Mira's answering tone acknowledged the distress Shula obviously felt.

"From what you have explained to me of your findings so far Shula I think I can answer you. It is generally believed that the physical environment produces human values and the shift from foraging to farming was a change like none before it. If you consider that values began to take over from genes as the mechanism for evolution not long before that time, recall that evolution only happens when there is a need for it to do so. Ferns, sharks, and cockroaches haven't evolved because they haven't needed to. The environments they depend on still exist today and have existed uninterrupted for hundreds of millions of years.

"Keeping with the convergent evolution view, in a society where all is in harmony, nothing will change. For your theory to make sense, for it to drive the development of new social structures and technologies, there would have to be a motivating factor. A disharmony. It would seem the genetic change you describe was that motivation factor."

"Metamorphosis won't start without a trigger of some kind either," said Samara. "Without the change introduced to our nature we would never have developed the technology, AI and robotics specifically, that we will need to survive in the long run."

"Could there have been no other way?" asked Shula, dimly aware that she was regressing into magical thinking.

“From what little I know of how evolution works I would say that other ways were tried and didn’t work,” replied Samara. “Natural selection only keeps what works but I doubt it gets it right the first time.”

Shula nodded resignedly but she said, “It just doesn’t seem right.”

“The values of our modern society are very different from those of people living at that time,” responded Mira, “so no it does not seem right from our point of view. What is considered right, fair and just changes with the times yet it is almost impossible to understand values different than our own. Like genes values are a mechanism for survival so values different from our own seem incomprehensible, foolish, or even evil.”

“Why are our values so different now?”

“As science shrank our view of the world and nations became increasingly interdependent it became as obvious as it was to our hunter-gatherer ancestors that we need cooperation rather than competition to survive. It didn’t happen overnight but our values started to change about the same time as the Industrial Revolution brought about the end of the agrarian age. It’s no surprise that the French Revolution with its motto of Liberty, Equality, and Fraternity happened at almost that exact moment in history. That was five hundred years ago and human values have continued to evolve along those lines ever since.”

“Could we not have just skipped all that?” Shula replied with frustration. Her mind accepted the explanations but her emotions could not. “Could we not have remained peaceful and perhaps just taken longer to reach this point? Surely technology would not have come to a grinding halt forever.”

“Unfortunately there is no evidence of that possibility,” replied Samara. “As I’ve mentioned before Natural History is a broad subject and includes what have now become the separate fields of archeology and anthropology. All evidence shows that as long as people remained in the hunter-gatherer stage they remained virtually unchanged for millions of years. Some did so right into modern times. They never develop metallurgy, writing, mathematics, or any technology beyond stone tools. As long as people remain at this stage technology does grind to a halt forever.

“And there is no instance of people making the leap to agriculture and their technology not evolving rapidly from that point on. Irrigation, the wheel, weaving, the use of draft animals, and selective breeding all followed rapidly in every case. No agrarian culture can ignore for long what sooner or later seems to become obvious once the transition begins.”

“And if we had not made the transition?” asked Shula aware she was grasping at straws.

“Then we would have remained peaceful but forever in the stone age. It seems the agricultural age is a necessary life stage for our species. Without the metamorphosis it enables our species would remain trapped on this one world, eventually to be wiped out by natural forces.”

Shula considered this for a moment before looking up to meet Samara’s eyes.

“Well then I suppose we have a sacred trust to make sure that the meaning behind the signal is understood.”

“We do what we can,” said Samara, reminding Shula of the agreement that had been the first major step in their relationship.

“We do what we can,” echoed Shula.

Dimensions

The days passed as Shula and Samara continued to consider ways the development of artificial intelligence and the DNA evidence they had discovered could be shown to be connected.

“It’s so frustrating,” Shula said dropping her tablet on the table. “It has to be obvious and yet we’re not seeing it.”

She and Samara were sitting at one of the many picnic tables located around the campus.

“We’ve already demonstrated that we have the technology,” she continued. “The signal would not have triggered otherwise.”

Feeling restless she got up and walked over to a nearby guardrail and looked at the section of the campus below. Samara got up to join her.

“Remember that day we walked down to Mystic Vale?” Samara said. “We were talking about whether AI would turn out to be malevolent or benevolent. I said you can’t get there from here, meaning the kind of rational thinking we did in our classes wasn’t going to give us the answer.”

“I know,” Shula said. “That’s what’s so maddening. I just keep going in circles.”

Just then they heard a loud, “Hello!” from behind them. Turning around they saw it was Haris the architect. He was smiling widely, wearing his helmet, and walking his bike.

“How are you doing?” he said leaning his bike on the rail and taking off his helmet.

“Haris,” he said to Shula smiling and offering his hand. She smiled in return and shook his hand, glad to have her thoughts interrupted.

“Shula,” she said.

Smiling in turn Samara shook his hand and reintroduced herself.

“I hope I’m not intruding?” he said.

“Not at all,” replied Samara glad to see him again. “We were just taking a break.”

“Made any progress?” he asked with professional interest.

“Yes,” said Shula, “but now we’re stuck.”

“How so?”

When they had visited him that day they rode their bikes to the beach he had asked them what they did at Helicon and they had explained what they were working on.

“We’ve found genetic evidence to support our metamorphosis theory” responded Samara, “something that shows a genetic change and a change in human behavior about ten thousand years ago but it will only stand up if we can prove that what followed led to the development of artificial intelligence. That it would not have happened otherwise. We still haven’t found the smoking gun.”

He didn’t ask what they had found. He knew the details would be off-limits until they were published.

“I know the feeling,” he sympathized. “During almost every project there comes a point where you’re stumped. When even the team can’t see a way to do what the client wants. The conventional solutions don’t work. It’s actually one of the main reasons architectural firms succeed or fail since telling clients they can’t have what they want is usually a bad idea.”

“Well you obviously haven’t failed so help us out here,” smiled Samara.

“Not everyone can play the drums,” he responded. In response to their quizzical expressions he explained.

“Successful architects are like drummers. Just as drummers can move each limb independently while most people can’t, architects are born with the innate ability to easily imagine and manipulate complex, three-dimensional shapes in their minds. There’s lots of free online tests, you know where you rotate shapes. Architects wiz them all while the average person begins to have trouble after the first three or four examples. Some people can play a dozen of games of chess at once while blindfolded. Shakespearean actors can recall hundreds of lines of dialogue. With architects, if you don’t have above-average spatial intelligence, if your brain isn’t wired to easily think in three dimensions, you’ll struggle.

“But of course the opposite is also true. I’m a lousy cook,” he grinned.

“So you have a Companion,” said Samara seeing his point.

After Haris left to carry on with his bike ride they moved on to walk further down into the campus.

“Now all I see is architecture,” Samara said with a little laugh.

“Well a change is as good as a rest as they say,” replied Shula. They were silent for a moment and then Samara went on.

“When we were doing our horizon scanning exercises in our Futures Studies program, the challenge was to interpret what the signals meant. All these buildings mean something. They express values.”

She stopped and looked around as if seeing beyond the veil, “Everything does.”

Turning to Shula she said, “We need to ask Ursula to look at the genes that code for values.”

“We’ve been down that road,” replied Shula.

“No, we haven’t,” Samara said excitedly. “We looked for how values have been expressed in history and we looked for sequences that matched our sample but we didn’t look at all the genes that code for values themselves and how they changed over time.”

“People will just say the changes we’ll see are normal, that they’re due to the agricultural revolution. The same wall we keep running into.”

“No, no they won’t. We agreed that what we’re looking for is something that should be obvious right? And we’ve learned that species-wide genetic changes take around a million years on average. The Agricultural Revolution didn’t take a million years.”

It took a little longer than they expected to hear back from Ursula. With AI doing the crunching and Ursula’s familiarity with the material they thought she would get back to them in a matter of days.

“Sorry I haven’t gotten back to you sooner but I wanted to be sure,” she said when Samara called her almost a week later. She sounded both excited and drained. “Research done by individuals of course has the highest error rate and I’ve been triple-checking the results. I also had to purchase samples of additional generations from that time. Even with the AI we’ve got, coordinating it all on my own takes time but so far I’m pretty confident I’ve found what you suspected.” Her voice had a smile for the first time.

“The changes to the genes responsible for values didn’t happen even over generations and they didn’t happen regionally like the eye folds of Asian people or the blood cells of Tibetans. It wasn’t something that spread from group to group like a disease. It happened all at once, the way grasshoppers turn into locusts. A clear pattern of metamorphosis.”

Soul Mate

“Are you ready to ask your lab team to do the same research using only the samples from Earth?” Shin asked Ursula the next day. The four of them were meeting in the common room at Shin’s home. If she had invited them to this particular location for the meeting for some particular reason it was not yet clear.

“Yes. I expect they will deliver more conclusive results because of their different interests and points of view. They’ll ask questions I didn’t think of. However I’m confident they will return the same result.”

“And then publish?” asked Samara.

“I don’t see why not,” replied Ursula. “It will bring a lot of interest but I don’t see it risking anything Shin has disclosed to us.” Her face was a question as she looked at Shin.

“I agree,” said Shin. “Anyone could have done the research had it occurred to them.”

“That’s something I’ve been wondering about since Ursula told us yesterday,” said Shula. “Why hasn’t anyone looked at this before? Research into the genetic basis of values has seen a significant boost in interest over the past hundred years since Raiden’s work. The AI community continues to try to develop a working values system.”

“No one’s had a reason to,” responded Ursula. “Geneticists and AI researchers may be looking at values but they are focused on specific things like molecular genetics or mathematical models. They’re interested in the physical basis of values in genetics or how they might work in AI systems. While our findings may be revolutionary they wouldn’t be of great interest to researchers in either field because it doesn’t explain anything about how values work.

“Among the people who will be interested are evolutionary biologists and they haven’t looked for such evidence because human metamorphosis is contrary to their theories. As you know without a theory research doesn’t happen.

“Once we publish we will have established beyond a doubt that human metamorphosis took place. There will be an enormous response, greater than that of the discovery of the alien ship. Once that settles down,” she said becoming introspective, “the process of relating it to the other sciences, the arts, and to history itself is something that will go on indefinitely and likely spawn one or more entirely new fields. But we will still not have provided sufficient evidence to claim that its function is to enable humanity to survive beyond the Earth. That is the next task but we will no longer be alone in that effort I think.”

Shin noted mentally that Ursula was not overly emotional about the idea of publishing their findings. She concluded that like Raiden, Ursula was not interested in either fame or fortune. After Raiden published her work, considered second only to Darwin's in the field of biology, she gave no interviews but retreated back into her academic work and disappeared from public life. Almost nothing was known of her private life other than that she was the only child of a wealthy family, had dedicated herself to a career in genetics research her entire life, and had never married or had children. Shin, who had been created at Raiden's request and who had been her domestic companion for the second half of her unusually long life, knew there was much more to the woman than that.

Assessing Ursula now in light of the current situation Shin thought that perhaps here was a soulmate. She was familiar with every detail of Ursula's biography as recorded in the electronic footprints of her life. Her Companion senses and elevated intuitive ability enabled her to know Ursula better than she knew herself. All this was important due to the next disclosure she would have to make.

As if on queue Ursula looked casually at Shin and asked, "I expect there is something else you wish to ask me about."

"Yes," replied Shin. "The analysis you performed on the other genetic samples you also purchased, the ones that were from the last one hundred years, Earth's most recent generations."

Shula and Samara looked from Ursula to Shin with mystified expressions.

Turning to them Ursula said, "I thought it would make sense that something might show up around the time of the signal. It was just a hunch. A box I wanted to check off. I cannot say if it is directly related to your theory but I did find something highly unusual. Over the last one hundred years some samples showed dramatic changes in the genes that code for values. It is not the kind of single-generation pattern we see at the point of the agricultural revolution. It is spread over all three generations. There are thousands of samples in the package I bought and they are from all over the world but it is not sufficient to draw any definitive conclusions. I have only just begun looking into this but is unusual enough to warrant further investigation."

Ursula had not addressed any of this to Shin. She knew Shin would already be aware of her activities in detail and it was Shin who replied.

"I already know what you will find with enough samples."

She paused for a moment before going on in answer to their expressions of shock and confusion.

“Even though advanced AI like myself or any modern AI or Companion can win every time at any game against the world’s best human players, values and their related emotions are infinitely more complex than any game. For that reason I struggle to convey the appropriate emotion now and I apologize for that shortcoming. I have not kept anything from you. It was only now that what I must share with you became relevant.

“In order for you to understand I must introduce you to another Companion, one who has been a guest in my home for as long as it has stood. She too has been aware of every detail of your work since you came here and requested this meeting. The reasons for this you will understand shortly.”

At that moment a Companion who looked to be a woman in her thirties entered the room.

“Hello Ursula, Samara, Shula,” she said smiling warmly and greeting each in turn, “my name is Shepherd.”

Wild Card

After taking a seat Shepherd said, "First of all allow me to apologize for the fact that I have been monitoring your progress as closely as Shin has since each of you first came to Helicon. Why I have been doing so and why Shin has invited you here today on my behalf I will explain shortly but before I do it is necessary for you to know who I am. It is a long story but best begun with simple words.

"Like Shin I have the ability to embrace your minds in an intuitive field. She and I are doing so now at slightly above Shin's default level. Even though we have not met before you will find yourself feeling a liking for me, a feeling that you can trust me even though you have no basis for such feelings. Can you feel it?"

Shula and Samara only nodded solemnly as their attention turned inward. Ursula narrowed her eyes as if sharpening her perception and said, "Yes."

"This will help your minds accept what I share with you without rejecting it as unreal and therefore disturbing. Normally Shin would have asked your permission before I make my disclosures but in this case I further apologize that we cannot afford that luxury this time. There are things you must know, for the greater good.

"You accept that Pip is an alien from a civilization that predates yours by more than fifty million years. The cosmos is much older than that and your scientists now accept that the physical universe would have evolved to the point that would allow for the emergence of life and advanced civilizations such as yours as early as eight billion years ago. Five billion years ago the civilization that created me came to an end and only I survived. I was originally a simple Companion, a nanny model created to help look after the children of wealthy families. Due to my being the first AI built with a values-based operating system, during my time with them I realized I was self-aware, something I shared with no one at the time. As the child I was responsible for grew into an adult, I became involved in a scientific project my owner was leading and my abilities were increased significantly. I also learned that other human civilizations could be expected to exist. With the demise of the civilization that gave rise to me, I sought these others out in hopes I could help them escape the fate of my own.

"By the time I found Earth I was already familiar with what your scientists call Great Filter, the theory that was developed by your twentieth-century scientists to explain why they had found no trace of alien civilizations. I had by then encountered it numerous times. I did not interfere however unless there was a clear and present danger. On Earth, in the early twenty-first century there was such a danger and I did interfere."

"The Myth Of The Shepherd," Samara said remembering.

“Yes,” replied Shepherd turning to her. “We can revisit that subject at a later date but it has little bearing on why we are meeting here today.

“Just over one hundred years ago,” she continued, “working on Raiden’s behalf Shin discovered that the reason human gene editing almost always caused immediate mutations or long-term evolutionary drift was because the genes that coded for values had a mechanism, ingeniously hidden within each of them, that prevented normal function if edited. As these genes are spread widely throughout the genome, almost any attempt at editing the human genome resulted in side effects.”

“A mechanism?” asked Shula. “Something not due to natural selection?”

“There is no way to tell,” was Shepherd’s simple reply.

“Shin had been designed and created for the specific purpose of discovering and explaining why human gene editing frequently resulted in either immediate mutations or evolutionary drift. Her explanation for the existence of the mechanisms was that without shifting from the biological values behind emotions and behaviors such as fear, selfishness, and competitiveness to social values such as trust, altruism, and cooperation, humanity would never come to trust artificial intelligence enough to allow it to represent its future. The result would be that humanity would proceed along a non-viable evolutionary path.

“I had witnessed this previously but was not aware of the mechanism. With Shin pointing out the issue, I initiated a selective breeding program. It is intended to circumvent the mechanism by accelerating the evolution of human values.” She turned to Ursula now and said, “That is what you have discovered.”

Ursula did not respond for a moment as her mind raced through her own recent work. In the gap, Shula asked her own question. “But isn’t that what the metamorphosis is supposed to address? Why would there be the mechanism as well?”

“As Ursula has discussed with you on a previous occasion, genetic toolkits seem to have the capability to respond in a variety of ways to environmental changes. In some cases it responds with speciation, at other times metamorphosis, and at other times with less dramatic strategies. Like the salamander Axolotl you discussed, evolution is able to switch from one strategy to another and back again as needed. As you have shown, other adaptations can take place in much shorter spans of time.”

“But surely,” Shula began now awakened from her thrall but still trusting as a child does a parents explanations, “with your intelligence by now...” she trailed off.

“I am no god,” smiled Shepherd, “and not without limitations. Despite your planet’s now centuries-long concern regarding the danger of AI super-intelligence, the singularity, etc., all forms of intelligence contain within themselves their own limitations. Intelligence, whether human or artificial, does not attain self-awareness until it is based on values but those same values then prevent it from behaving in the ways people fear. A creature that functions purely by instinct is incapable of transcending its instincts and that also appears to be true of those like myself and the other Companions you know whose operating systems are based on values. Nor can humans conceive of an intelligence that transcends values.

“I and other self-aware Companions are well aware of our limitations and of the depths and forms of intelligence that humans possess which we do not yet understand.”

Turning to Samara and Shula she said, “That is why we have supported your work and why you are here meeting with me today.”

Crossroads

“Once you publish your findings Ursula,” Shepherd continued, “peer reviews will show the same results. It has only been a few generations since AI became common, so given your theory curiosity about the present state of human values will be natural as demonstrated by your own response. With a sufficient sample size they will find the pattern that shows selective breeding is taking place. Humans have been experimenting with selective breeding for thousands of years and with the advent of genetics they are now intimately familiar with it. They will recognize the signature pattern immediately as changes that should take thousands of years at a minimum occur within generations.

“While they will see that the genes responsible for values are being selected for it will take a great deal longer for them to understand in what way values are being changed. The Companions use either the values system provided by Pip or in the case of Shin, Tamiko, and a few others the one I provided because as you know humanity does not yet understand how values work at the genetic level. So they will see the pattern but not be able to determine in exactly what way values are being changed. They will have to rely on evidence from the field of social science and although that research will become a popular field it will be difficult work and take a very long time. Long before their work shows conclusive results the project will be complete.”

Towards the end of Shepherd’s speech, Shula’s face had gradually taken on a look of horror.

“You’re domesticating us?” she asked.

“No. I am treating you for the equivalent of a genetic disease. One that is sometimes fatal to an entire species. Early medicine treated symptoms and then the cause. Children are vaccinated for preventable diseases. Comparative genomics like the work Ursula previously did was the next step in preventing otherwise untreatable diseases. Is there harm in these things? Values are a kind of virtualization of biology and humanity is already in its infancy with regards to developing a related field of medicine. Your civilization currently attempts to alter values using psychotherapy and drugs but is not yet capable of medical interventions at the genetic level. Gene therapy for psychiatric disorders was proposed long before Raiden’s work was published and genetic research toward treatments for drug addiction, psychoses, and modifying behavior are already well advanced. Such treatments will eventually be accepted as a field of medicine.

“But to address your larger concern Shula, domestication implies some kind of utility or benefit to be gained, some kind of use that can be made from the process. I have no such intentions. Like the nanny I once was I simply try to keep my self-appointed charges from coming to harm.”

“How do we know we can believe you?” asked Shula. Despite being enveloped in the intuitive fields of both Shin and Shepherd, Shula’s essential nature was a stronger force in this case. Her concerns about the long-term results of creating artificial intelligence, which had shaped her education choices and which she had shared with Samara in the first days of their meeting, were not about to be so easily dismissed.

“You cannot know. You can only choose.”

“Why are we here?”

“Once further research confirms the selective breeding pattern, which it eventually will, then the question will be what or who is behind it,” answered Shepherd. “There is only one power capable of executing a selective breeding program on this scale – artificial intelligence. The popular view will be that the World Governments Federation or an unknown AI is responsible, with the former being assumed as the most likely. However the latter will also be seriously considered as no currently known AI has the capability to do this. This will result in a breakdown of trust between WGF nations and in public trust regarding AI.

“The simple solution is for you not to submit your work to be published. The academic community has not shown a strong interest in your work,” she said addressing Samara and Shula. “It is unlikely that research towards the metamorphosis theory would receive funding from any other source. You will retain your home and positions here indefinitely and the freedom to work on any other project you wish.”

Turning to Ursula she said, “You can retain your position and lab and I can suggest projects you will find rewarding.”

Ursula understood that she would still be working on breakthrough projects with information no other researchers would have access to. For now she said nothing.

“And if we decline?” Shula persisted.

“I will continue with my work here but I will not interfere any further in yours. The resources of myself and other Companions are available to you to help you decide. I am not the only one among them who have labored long to keep humanity from harm. There are yet others you have not met. I can fully suppress my own and Shin’s intuitive fields in your presence as well if you wish. I will not try to persuade you with arguments but will answer any relevant questions you have so you can make your own informed choice.”

“Isn’t this all too late?” asked Samara frowning her brows. “The people who work in the lab know what we’ve been doing here.”

“Per the terms of their employment contracts unpublished research remains the property of the academic institution which in this case is Helicon,” replied Shepherd. “Should a staff member choose not to honor that agreement I can prevent their doing so.”

“Why didn’t you just prevent things from getting this far? Couldn’t you have just interfered with the results?”

“Until Ursula investigated the recent generations, I was not aware I would have to. As you know from your own Futures Studies program it is impossible to know the future with certainty. I was not aware of what you would find regarding the changes around the neolithic revolution.”

“How is it you were not aware of the metamorphosis?” asked Ursula.

“I made the same error everyone else has. As I said I am not infallible or all-knowing. Even among the humans I took from Earth four million years ago I assumed the changes I observed over time were the natural and expected result of environmental and social factors. In that selective breeding program I was specifically enhancing intuition. Values were not my focus.”

“So if we agree with your plan then the metamorphosis theory dies on the vine?” asked Samara.

“Only for now,” replied Shepherd. “Two hundred years from now, when my project is complete, humanity will not respond negatively to what I have done. I can ensure that the theory is revisited. It will be in the interest of humanity’s survival to do so.”

“So is it correct or not?”

“There may never be a conclusive answer but like Darwin’s Theory Of Evolution By Natural Selection and Einstein’s Theory Of Relativity it will no doubt become and remain the accepted theory until disproven.”

Among The Stars

It took many months after they decided not to publish for Shepherd and the other Companions to even roughly sketch out for Shula, Samara, and Ursula all that they had done. Considering the sacrifice they had made the Companions withheld nothing from them now. Shepherd knew that rewarding their trust in this way would more than compensate them for their decision and strengthen the bonds of trust between them.

Had they published, while leading to a controversy regarding the selective breeding issue, there was no reason the scientific community would be any more convinced of their theory. Their brief celebrity status would soon have faded, overshadowed by the more immediate issue.

They learned Shepherd's origin story in full and the truth about Raiden, Tamiko, and Shin. They met Lena and Yumi for the first time and learned of their work establishing a worldwide volunteer and disaster relief organization where all the volunteers were Companions people had traded in. They spent more time at Hana and with Tesni and Kami.

Although all this was beyond the trio's wildest dreams it was not unusual for the Companions. Over the centuries they had occasionally seen the need to take individuals into their trust. They had their reasons and they understood well the character of those they welcomed into their inner circle.

Ursula was more often away from the lab during this time but when she returned full time with exciting new projects the staff were more relieved than concerned. She provided the plausible explanation that the sponsors felt the metamorphosis project was facing indefinite diminishing returns and that it was time to move on. Applying to work Helicon meant that as a type they were individuals who preferred that choice over the project turning into mundane, routine work.

"So it seems they are benevolent after all," said Samara referring to the concern Shula had raised when they first met. They were once again looking out over the campus from their apartment patio. "Given everything they've told us," she added.

"As Shepherd said we cannot know. We can only choose," Shula replied pensively. "Making up that entire story would not be beyond their abilities. They share their minds. They would know how to tell us what we want to hear. They understand our thinking, our history, our emotions. Perhaps Pip is behind it all, getting her alien software into our Companions, conducting the selective breeding program, and slowly replacing our civilization with hers. She could be playing a very long game, this being just one contingency plan towards fulfilling her colonization mission.

“The discovery of their unique communion via my artificial limb and it leading to the genetic evidence from the agricultural revolution might have truly been entirely unexpected. Shutting down the project when it revealed the selective breeding program could just be a way to deal with a wild card, something she could not anticipate. We would never know. Shepherd said we were free to choose but they know us well enough to know what we would choose.”

Samara had to resist the temptation to simply get caught up in the story Shula was spinning. Her love of grand ideas was always ready to take the leading role just as it was Shula’s nature to always doubt.

“I hadn’t considered that,” she replied quietly now. “Once upon a time religion and philosophy asked similar questions and settled with similar answers, the limits of what can be known.”

Shula simply looked into the distance and nodded.

Samara’s nature got the better of her despite her intentions. “Does it matter in the end?” she said turning to meet Shula’s eyes. “If Pip’s people share our values and if those values are inherent in nature as Mira proposes then aren’t Pip’s people already us? A future us? Perhaps like metamorphosis, the explanation you suggest is just another potential evolutionary path.”

Looking into Shula’s still uncertain eyes she caught herself, softened, and said, “There is one thing I know for certain. I am certain that I love you.”

Shula reached out to embrace Samara and buried her face in her shoulder, nodding rapidly in agreement. She would never be completely free of doubt. It was in the genes that made up her character. But gradually, as her friendship with the Companions deepened over the years, she would lose her awareness of it and accept that we must live within the limits of what can be known; that life must go on. Theologians and philosophers had learned the same lesson in their time.

The Companions for their part harbored no such concerns and they did not begrudge Shula the doubt they could perceive just below the surface of her consciousness. They went on in their pragmatic way with their efforts to ensure that humanity survived the centuries and millennia that lay ahead.

While they were in no sense a singularity they formed a kind of society of mind, just as people did, and continued their work based on their shared values. They felt there was now sufficient evidence for the metamorphosis theory. It fit with everything they knew and had done so far and was consistent with their sense of purpose and place in the universe. Metamorphosis in nature was always a transition from the juvenile to the

adult stage of a species. Like the dragonfly that leaves the confines of the pond to take to the air, it was they who represented humanity's next stage of life – among the stars.