Earth - Flower – Cloud - Mind

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With delicate precision, Zahra* positioned the stretchy-film, plasmon-electrode array, upside down, on her forefinger and gently applied the sensor to her left temple which adhered with only the slightest pressure. Then, another, to her right temple. One-by-one, she continued attaching the wireless, neuro-sensors to key points on her cranium, following the diagram provided with the Do-It-Yourself EEG kit. She checked the configuration of electrodes (24 unique sensor units in all) with a small mirror she had brought along. All looked good.

Zahra laughed to herself, imagining the curious or comical impression she might make on someone who chanced to walk by. But she was too excited to really care.

This was her favorite spot in the world that she knew: a low-sloping mound rising just above the grassy environs with a shading and solitary 'tulip tree' -- its flame-like flowers in full bloom -- at its summit; she had been coming here since she was a little girl to read or to think. As she grew older she would risk coming here at night, alone (with just an ultra-OLED light and walking stick), to gaze at the brilliant view of the *Njia ya Milky* (The Milky Way).

She had been a keen observer of the world around her with all its unique and natural topographic features for as long as she could recall. And yet, the more she looked, and listened, the more she would see: water-rich termite mounds rising higher each day until they just stopped growing (*signifying a mass die-off?*)…small groups of young elephants 'talking' and 'listening' to far-off herd members through their giant, flattened feet…huddles of hungry 'painted wolves' (wild dogs) sneezing, in turn, until consensus to hunt was reached…and low-vibrato grunts of rogue male gorillas that had ventured too far down the mountainside (*in search of…what?*)…and of course, the myriad streams and mercurial rivers that meandered through this vast, rifted, river valley that was her home – bringing

successive regime changes in vegetation and animal visitors as their currents quickened or slowed, their levels swelled and receded…And, more so each year, the changes wrought by both Nature (the seismic forcing-apart of the two tectonic plates comprising the valley) and her fellow humans as they altered and reclaimed land for their own industrious purposes. She wanted to know and see so much more; she wanted to understand it all – and with a sense of intellectual, even *existential*, urgency that comes from sensing and seeing the ever-evolving impacts of a changing climate. Although her exact plans for attaining this were still somewhat inchoate, she felt deeply that this understanding was crucially important to her community, her country, even the planet.

Most of the advanced EEG kit had been 3D-printed with bioplastic block co-polymers and provided to her through a local *maker-tech* co-op that had set up shop at the outskirts of her native village which was itself situated on the border line between the eastern highland savanna and lowland forest of this Kenyan part of *Maziwa Makuu* (the Rift Valley 'Great Lakes' of East Africa). Her village made great use of the co-op, as it provided easy and cheap access to everything from micro-electronics and basic medicines to printable PV cells and handicraft accessories. Co-op members could trade in-kind or earn credits for doing 'big data' assimilation (*something humans could still do as well as robots!*). The co-op also gave workshops on participating in Virtual Reality-enabled MOOCs – massive, open, on-line, (college) courses. The latter, in particular, was something Zahra had been dreaming of, and preparing for, for many years now.

And here she was; she had done all the work, studied all the books (digital and physical), taken all the tests, registered and enrolled…and now, soon enough, her intellectual development would enter its newest stage.

Satisfied with her preparation, Zahra checked the power level of the solar collector-cell unit (*check* – power at maximum), verified that she had a working, high-speed, Internet connection (all

provided by an inflatable, next-gen GATR antenna kit that she carried in her backpack), and then coolly slipped the ultra-sleek VR viewing 'glasses' over her eyes, its temple supports gently grazing the sides of her head. She had thoroughly read the 'specs' on the glasses: embedded along left and right temple supports were a series of CMOS-based, micro-gate-all-around arrays that sensed even minute voltage changes from the plasmon-electrodes (which were all wirelessly networked). In this way, the sensor arrays could detect and measure both proximal and distal activated neural circuits at high-spatial resolution (*No need for costly and risky neuro-implants!*), and even strengthening or newly *emergent* circuits – both of these being 'proxies' for types of *long-term potentiation*, or memory formation. This sensor data provided continuous feedback to the VR program's *neuro-net-map simulation.* Supposedly, so Zahra had read, this simulation could be 'taken over' by any AI (artificial intelligence) with access permission. Admittedly, the thought gave Zahra a moment of pause, as a ripple of nervous excitement coursed down her spine.

Although she had brought along her old, roll-up, thin-film display, mostly out of habit, she was assured that no such *unintegrated* hand-held device was required – all communication took place between her brain, the VR-EEG system, and the 'Inter-Webs', as her father used to call it, while all processing, computation, and active memory took place *in the cloud*. And, the maker-tech folks also signed her up for her own personalized 'cloud intelligence', or *AI mentor*, whom she would encounter at some point.

If everything worked as it was supposed to, that is, if all components synced-up seamlessly, Zahra would soon be interfacing with her very first PLS (Personal Learning System). The PLS dynamically adapts the instructional pace and course content presentation (whether visual, auditory, or mixed modal) according to the continuous monitoring of -- and feedback from -- the simulated network of brain circuitry which she had just now initiated.

A green, visual word-prompt in Swahili appeared, blinking, before her eyes; it was asking her if she was ready to begin the program. Smiling, she felt another rush of nervous excitement. Zahra nodded for the program to begin.

A sonorous and androgynous voice introduced itself, first in her native tongue and then, repeating itself, in precise English:

”Greetings, Zahra, I am your *wingu akili*, Rafik, and I will be your personal guide as you engage and explore the NILE (Neuro-cognitive Inclusive Learning Environment) program...”

Zahra inhaled deeply and smiled an eager smile. Here it was – her first AI mentor. *My new, personalized, educational journey has begun!*

”Are you ready to proceed?”

“Ndiyo!”, she replied, confidently.

“Very well…To begin, you may now select your school choice curriculum and initial course content.”

Zahra noted, silently, that her ‘cloud mind’, Rafik (the name comes from *rafiki*, or *friend*, in her native Swahili), spoke in both Swahili and English, shifting fluidly and instantly between the two, and seemed to do so depending on which language Zahra’s particular thoughts adopted at the moment. It was almost like Rafik could ‘read her mind’! Of course, she realized that Rafik, being an AI, was constantly monitoring her cortical-neural circuits and comparing or mapping their activity to a previously compiled library of test subjects’ brain responses, including her own, based on tests she had taken earlier, in preparation for enrollment in this NILE program. ‘*Mind-reading’ was all about having just enough of the right information at the right time…*

"That's easy!" she said aloud, in English. Zahra had been waiting for this moment for many years. "*MIT. Introduction to Geosciences.*"

Zahra could speak English nearly fluently (it was taught starting in grammar school) but she had learned it first from her grandfather who had picked it up from the Leakys – the famous anthropologists – whom he had worked for on several of their famous digs. At one of these digs – long before she was born and her parents were still little children -- he had been working with Meave Leaky (the anthropologist and wife of Richard Leaky) when her team, digging near the shore of nearby Lake Turkana, discovered jaw and skull bone fragments of an unknown ancient *hominin*, later to be named *Kenyanthropus platyops* ('flat-faced man of Kenya'). The bones would be dated to nearly 3.5 million years old and her grandfather had actually discovered small fragments of chipped *chert* stone – evidence that her ancient countryman ancestor was a tool-maker (perhaps the earliest ever discovered!). *Surely, there were more fossils of his kind to be discovered…? But, where were they hiding?* One day, she promised herself, she would somehow try to answer this question…

Zahra snapped herself out of her day dream. *Time to focus now*, she prompted herself.

"Very well, Zahra. I am now engaging the Open Education Consortium portal…signing in…and from there, after a few moments of data verification, we will jump to the Massachusetts Institute of Technology's *Open CourseWare* module for Planetary Sciences - Geoscience."

There was a slight *whhurrr* sound for a second or two as her visual space transformed from a translucent view of her actual surroundings to a decidedly opaque, 3D graphic of a multitude of inter-connected pipes or tubes, which she felt herself 'navigating' through at high speed. The nice lady at the maker co-op had mentioned this, explaining it was a visual play on a very old 'screen-saver' joke – that the Internet was a 'series of tube'…*Ha!* However old or silly, it still worked as a visual metaphor of virtual space. Zahra grew more excited. But also, she began to feel a growing sense of nervousness. *What if I'm*

not ready? What if I'm not as smart as I think I am (like my parents always told me I was)? Is this a world where I belong…a world where I can succeed?

Rafik interrupted her rushing thoughts:

> "I sense that you are feeling nervous or uncertain. That is natural for any new educational experience in an unfamiliar environment – real or virtual. Just remember, Zahra, that you now join a global community of students from nearly every nation on Earth…Diverse students who also share similar nervous feelings and uncertainties…and whom also share most of your core values, such as self-betterment, intellectual curiosity, social reciprocity…and, you each indicated the great value you place on familial and communal connectivity and support…This you already know from the group survey you participated in… You may rest assured that you are a valued member of this global community…and, you may contact other members, for social and/or intellectual exchange, at any time…"

Zahra inhaled deeply and exhaled slowly. *Of course*, she realized, she *was* ready for this challenge, and after all, despite her unique personal story (and her current solo effort in the virtual world), she was not alone. This virtual experience had a real-world, community presence backing it up (whose members were like her in many ways). And, one day, she knew she would meet IRL some of her fellow NILE explorers…

The tubular matrix (the old-joke-graphic) dissolved and before her appeared an avatar of her 'Introduction to Geocience' MIT professor, a Dr. Roberta Southard, who was, *somewhere* on Earth, an actual professor of planetary and geosciences (and the daughter of Dr. John Southard, who first taught the course back in the 2000 teens). The professor could, through her dynamically programmed avatar, interact with Zahra and answer any questions she might have, at any time. Unlike old-school MOOCs, each student had her own 'time stream' which could be stopped and started again, as needed. Here,

there was no pressure to keep pace with the fastest learners -- or the speedy presentation of a half-engaged teacher.

Behind the smiling professor, extending across Zahra's full field-of-view, was a multi-paneled whiteboard. On it, printed in large, dark blue letters, was the course number and title: *12.190 - The Environment of the Earth's Surface (MIT)*. An Augmented Reality over-lay – a translation into Swahili -- appeared just above the English words. (*How strangely 'meta': an AR overlay inside a VR world!*). The 'start' icon began blinking again, awaiting Zahra's OK…

Sensing a slight hesitation in her intentional neurons, Rafik offered:

"The professor's speech will be simultaneously translated into your preferred language and will be available for review in both auditory and written modes. Simply select from the AR menu with a gesture prompt, or say "command" or "select" and speak your choice of language and/or communicative mode…If you have any additional questions for the professor, or, about the course, that cannot be answered immediately by the professor's avatar, simple say "Outside Question", or type the phrase (using the AR keyboard), then type or speak your question, and this will be relayed to the professor who will respond to you personally. Also, if at any point you wish to make a note, simply say, or type, "Make Note". With practice, you will be able to effect commands via simple *visualization* of the gesture or action, as your *sensory-motor cortex* is continuously monitored and modeled by the PLS…Do not worry if you do not get things just right the first few times…Our heuristic programming is exceptionally flexible and responsive to your unique neuro-net map simulation. Good luck and enjoy your NILE program and Open Course Ware curriculum."

"Ok, ok…enough preliminaries…let's get going!" Zahra gestured 'begin' with a flourish.

Professor Southard's avatar began speaking while high-res images of geographical features accumulated on the panels, accompanying her words:

'Hello, Zahra, Welcome to MIT Open CourseWare! I am Professor Roberta Southard and I will be your instructor for the main parts of this course in Geoscience. As you may realize, a variety of natural and anthropogenic processes continuously impact the surface of the Earth. You will learn about most of these processes through course media, personal instruction, and hands-on field studies in your native locale. This is a multi-disciplinary course and will integrate aspects of soil science, chemistry, geology, topography, glaciology, hydrology, and climatology to provide a comprehensive introduction to Earth sciences. Throughout the course, we will emphasize key concepts and their practical applications to establish the foundation for understanding and intelligently managing the Earth's physical and chemical environment, and, lastly, to prepare you for your later field research projects.'

As the professor continued relating how much of geoscience data was acquired through a combination of sun-synchronous satellites and actual field measurements, Zahra had already noted that several of the images now fading in and out of sight were overviews of her native *Maziwa Makuu* region. Most likely, these stunningly detailed, surface images were taken by member spacecraft of the next-generation *A-Train Satellite Constellation*. Many images were variously enhanced by SQuID-based spectrographic sensors, each revealing subtly different conditions and states of the very land and watersheds that spread out all around her -- in the non-virtual world, that is. Zahra could select and *zoom in* on, or *zoom out* of, any photo she liked. In one over-head photo (taken from 700 km altitude over the Earth) she could see clearly (and examine in detail) the seismically-induced and growing chasm resulting from the separating plates that gave her Rift Valley home its namesake. The chasm zig-zagged diagonally southwest to northeast for hundreds of miles (and would, one far-off day, split this land from its parent continent). *Yes!* This is what she wanted most to see; what she was most excited about –

remote sensing and imaging…the Earth-Mind reflecting upon itself! She felt her heart beat increase, as did Rafik. The lecture stopped, momentarily…

> "Zahra, I have noticed that certain images are of particular interest to you…Would you like to pause here and begin a curriculum study plan based upon your perceived interests? Doing so will not obligate you to stay with this plan…You may change it at any time at this stage of the NILE module…You may also wish to define an *inter-disciplinary* curriculum of study. May I suggest a combined curriculum of space and geo-sciences with an emphasis on hydrology…?"

Again, as she was quickly learning, Rafik seemed to sense her thoughts well before she did. But Rafik's prescient guess was not *quite* on the mark. Zahra harbored a semi-secret desire; one she had carried with her since childhood; one sparked by the stories her grandfather had told her. Zahra remembered her grandfather describing the mudstone layers his team had dug through to find those ancient human fossils. The mudstone had preserved the fragile fossils. Mudstone was the hardened, fine-grain sediment deposited by over-flowing river systems. She had read about how satellite sensing -- along with LiDAR-equipped drones -- was often used for revealing and mapping archeological sites. *Could these satellites' spectrographic sensors be used to identify those ancient areas of river out-wash (now having shifted with time), and, possibly, the semi-buried mudstone itself? Might they also help find ideal locales for new, exploratory digs?* The possibility intrigued her, deeply. Rafik, sensing a pause in her thoughts, continued:

> "Just remember to include the mandatory field work of your preference in *at least two* sub-disciplines. I can provide a list of suggestions, if you so desire…As you begin your studies, you may also decide to list the names of researchers that you wish to work with, remotely…Always remember that higher education is no longer just knowledge acquisition, but also *knowledge application*. In this NILE program, you are not a passive learner, but a *learning collaborator*."

It was an idea that she hadn't even let herself think was possible, until now…*I could design the educational path I need based upon the knowledge and experiences I want.*

Zahra recalled the web-log she had read describing the possibilities and expectations of a basic professional degree (a 'PD', the equivalent in OCW of a Master of Science degree) now offered through the Open Education Consortium (and in compliance with the UN's Sustainability goal of 'quality education'). She would be expected to undertake some degree of self-driven, real-world research and share in the writing of scientific papers – just like the ones she read in professional journals. And, depending upon her progress and research, she had the option of pursuing an 'Intermediate Doctorate' (as a try-out for a full Ph.D. program). The cost of all of this personalized, innovative education was almost entirely *free*…Earning a *diploma*, however, came with a 'price' (for it was the name of the academic institution that one 'paid' for in a post-open courseware world); the cost of such a credential would be 'covered' by her signed agreement to make her work completely *open access* – all her field notes, research, and data sets…while any intellectual property (like a new tool or technique) developed while in the NILE program would be given first to the credentialing institution (while also shared freely with active NILE students), and then, after a modest period, given to the world, *in perpetuity*. It was an academic form of 'paying-it-forward'.

Up until the second decade of the 21st Century, such opportunities were once beyond the scope of a basic college degree (so she had read); seldom were undergraduates allowed to put their names on actual research papers alongside Ph.D. candidates, 'post docs', and Principle Investigators – never mind pursue their own research goals! But this was 2049, and the innovative-educational possibilities of collaboration with professional scientists (from across the globe) on her personal, self-driven research were now open before her…

But Zahra worried: *what if the interdisciplinary science curriculum I want to learn, and explore, doesn't exist? Well, then, I will just have to create a <u>new</u> science curriculum — forge my own academic path -- to acquire the learning that I need, so I may become the future me I am now beginning to see, for the very first time.*

Realistically, she understood that all this would take several years to attain (and likely involving open courseware from more than one university), but at the same time, it also seemed so *imminent*; so within her present grasp (*was this a strange side-effect of the immersive VR tech?*). This virtual experience, and the suggestion Rafik had made, sparked in her a spontaneous vision: a Zahra *si hapa bado* ('not yet here'). In this future she was engaged in a hybrid research project involving satellite-based, remote sensing, geo-environmental mapping and...*digging*...paleo-anthropology...in honor of her grandfather.

"Rafik, what about *paleoanthropology* -- combined with remote sensing and geo-environmental science?"

"That is a most interesting and ambitious combination, Zahra. Your native region is quite famous for its many foundational anthopological discoveries of early hominins by the Leaky teams, and others, such as *Australopithecus afarensis and...*

Zahra chuckled aloud, cutting Rafik off...

"You *don't say?* How *fascinating!*"

"I am detecting sarcasm in your tone and phrasing...Perhaps you are already aware of this fact? Yes, of course you are...I will note this in your personal profile so that I may reference it in the future. You see, Zahra, I do not know everything about you."

"Not yet, anyway", Zahra noted, bemusedly.

"Shall I add *3.997 Human Origins and Evolution* to your prospective curriculum?"

"Oh yes, please do, Rafik. Oh, and please do a search on any OCW modules in paleoanthropology that include field work credits in East Africa…and…"

Zahra suddenly started feeling a bit over-whelmed by all of this…as if she was now rushing head-long into that envisioned future…and fearing a collision with reality.

"Yes, Zahra, I will do that. Try not to forget that it is normal to feel both excited and anxious about one's educational prospects and plans. Do not let such plentiful possibilities, and advanced expectations, overwhelm you. You have as much time as you need."

Once again, Rafik played the near-perfect 'mentalist' mentor…and a reassuring presence, too, if an invisible one.

"Thank you, Rafik. I am glad you are my *wingu akili*."

"You are welcome Zahra. I am pleased that you feel that way. Would you like to take a small lunch break now?"

Zahra had just started feeling a slight rumble in her stomach. Rafik continued to anticipate her! But she was was getting used to him/her/it... *How funny!* She had not considered nor assigned a gender to her AI mentor, her friendly *cloud mind…*and she felt no urgency to do so either; her *wingu akili* was whatever it needed to be.

Zahra munched on a mixture of dried fruit and baked, *landrace* grains. She took a long sip of spring water, and surveyed the fluvial, lake-bejeweled landscape around her, noting the mountains in the distance. It was a beautiful land (*with buried secrets of our human past yet to be divulged!*). Zahra smiled. She had come full circle – Earth to Space and back to Earth – in the span of only a few

minutes...Yet in that span, she had seen her long-held, intellectual dream begin to manifest itself. Yes, it was only a small taste of what now lay open to her, and yes, it was a bit over-whelming...but also: *exhilarating*. She had quickly grown confident that she could take her intellectual desitiny into her own hands and forge the educational path that she envisioned...with a little help from her *wingu akili.*

But right now, a restlessness stirred in her.

"Zahra, I am standing by, ready to recommence the geoscience module, or, explore others, or, if you choose, continue assisting you in the designing of your educational plan...I am also programmed for music composition and dance instruction...should you desire more Arts content in your STEM studies...or have need of physical exercise."

Rafik: *AI mentor*, *cloud mind-reader*.

"Thank you, Rafik, that's a great suggestion! Could you play for me Stella Mwangi's *Haba Haba* song?"

She knew the lyrics, sung in Swahili and English, by heart: *Haba haba, Hujaza Kibaba* ('little by little fills up the measure')…It was one of her mother's favorite ('classic') pop songs and one they sometimes sung and danced to, together…And now, as she danced -- the song's rhythm reverberating through her -- she imagined her future-self looking on as one looks upon a burgeoning flower bud, delighted, and eagerly awaiting her arrival.

[The End]

*'Zahra' means 'flower' in the Zanzibar dialect of Swahili