

# The Universe and Us

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## The Scene

In Lembang, West Java, elevation 1300 meter above sea level, at 17:30ish. A group of people crowding around a portable telescope, with two professional astronomers at the “helm”. They take turn to peek hard through the eye piece of the telescope, while the rest gaze directly towards the western horizon, and look at the computer monitor connected to the telescope (Figure 1). Some are noticeably tense, but most just enjoy the opportunity to be in the scientifically what considered as sacred ground: an ageing astronomical observatory.



Figure 1. People trying to see the new moon

The object of interest? The moon. The thin sliver of new moon.

Once the sun sets and the western sky basks in orange, the crowd waits in anxiety, till the sky is dark enough, for human eyes, to detect the defining crescent in the sky.

The Islamic scholars have, despite minor detailed differences, universally accepted the definition of a new month in the Hijriyah calendar, a lunar calendar; a new month is set to begin in the evening the new moon is observed after the sun is set. The moon must have passed its conjunction with the Sun preceding the sunset. The verb “to observe” here is interpreted as observation by unaided eye; a tradition that has been propagated since the seventh century, benefitting minimally from the ongoing technological and scientific advancement in the field of astronomy. With this method of observation, visibility bounds to be subjective; and any matter that depends on subjective characterization ignites fiery sparkles within the society. Since the last decade the air quality in Java had decreased significantly. Surrounding big cities, one can see, if not feel, the smog. From the Bosscha Observatory

we can see layers of air quality and visibility which decrease with decreasing altitude. Consequently, observing the new moon has become significantly more challenging as the air immediately above the horizon is rarely clear. Figure 2 illustrates the difficulty in seeing the new moon on the western horizon after sunset. In the case shown in the figure the moon was seen for a few tens of seconds using a small telescope. Most of the time it was hidden behind clouds or haze. If the current pace of urban development is unabated, it is not impossible that one day quite soon we will not be able to observe the new moon at dusk, unless perhaps resorting to technology. Yet thus far it is not acceptable.



Figure 2. The new moon (bracketed by red arrows) observed on June 14, 2018

Archaic dependence on the Sky.

### Orientation and Timekeeping

In the Nusa Tenggara archipelago in the central-east region of Indonesia, each island has a star associated with it. Traditionally, a mariner uses the star to guide him through the open sea to sail to the island. Understandably sea travel is too challenging when the sky is heavily overcast.

Everywhere in Indonesia, traditional farmers depend on the visibility of certain stellar constellations to guide them through the season. The time to sow needs to be at the beginning of the rainy season, which is concurrent with the time Orion is at a certain height on the night sky. In fact, the Orion is called the Plough in Javanese. The reducing sky visibility and the global climate change have in the last decade confused the farmers. The season seems to shift erratically; the amount of water comes down from the sky at a wrong time, and the dry season lingers longer than it should.

Because the stars are so far, their annual relative motion is miniscule, and therefore their regular appearance on the sky has become reliable reference in time keeping. The Moon, being closer, offers its periodically changing phase as a timekeeper for a shorter time scale: the month. Not all planets in our Solar System has moon for their inhabitants to define their month. Physicists realize that there is no absolute reference for space and time. We borrow something that seems constant to us to keep track of our motion in space and time. That something is usually very far from us, or too small, to be involved in our dynamics. We now periodically correct our timekeeping for the various tiny effects which accumulate to relatively large amount for certain purpose in our high-tech life.

The loss of connection to the sky due to light pollution and atmospheric pollution might, to a small extent, be compensated by technological advancement, e.g. in GPS, subatomic clock. In fact. these

days massive urban development has made people depend less on the sky for their practical needs. Most people depend on technology that they do not understand the inner working of. However, humans do not connect to the sky only for practical purpose such as timekeeping and orientation. What humans aspire in relation to the sky is something deeper in their psyche than merely mundane references. As such the Anthropocene is as much terrestrial as it is social. Global warming and climate change have become two-word terms mentioned in colloquial conversations all the way to high level dialogues, with a wide spectrum of understanding of the real issue at hand. It is precisely this wide spectrum of understanding, framed by the context within which each person can relate, that creates chasms within society, for the non-aligned contexts results in the consideration people put in listing the order of priorities.

When the Hubble Space Telescope (HST) first released its amazing colourful photos of nebulae, stellar clusters, galaxies, even Earth sibling planets, it created a great delight. It was the first time amazing astronomical pictures entered homes through magazines and television and became the consumption of everyone, not only scientists. There was a huge response from the public at large, although only a few understood the new science the photos brought forth. It showed, among others, the glorious ring of Saturn. That we can, on clear nights, see Saturn with our naked eyes, makes the HST photo much more meaningful, because the direct vision of the beautiful planet has for millennia created an almost personal relationship. Thereby exist the ancient lore, known in almost all human civilizations. This are the few brief moments in our modern time, when science and technology take the back seat to let human archaic psyche direct our imagination and rekindles the triangle human-heaven-human relationship. It has been through this boundless imagination, structured with rigorous and patient observation of the celestial bodies over thousands of years, that humans constructed the study of astronomy. We then knew a few of the observed objects are close by, wandering across the night sky through the year, and we call them planets. The rest, the majority of things in the sky, are points of lights, dim and bright, the stars. Many of them appear and reappear faithfully, seemingly following the earthly season, generations after generations, in patterns that we identify as terrestrial beings that we know exist, or we dream exist: the great bear, the boat, the centaur, the dragon, ... They are not just decoration on the sky, they live and affect our livelihood, ruled by the gods the planets represent. The Universe and us were no stranger to each other. Science has of course reduced a great deal of the romantic part of this relationship, and replaced it with a narrative wherein causal relation based on physical sciences is the backbone.

The understanding of the causal relation and the regularity of the season has enable humans to predict. This ability is the key to the successful advancement in human civilization.

Ironically, while this causal relation is being continuously discovered, we see less and less of the sky. Either we are too busy looking, or the sky has become so light polluted, the air so polluted, that it is difficult now to see the stars. With their glowing orange night sky big metropolitans are lucky if they can spot Jupiter, Mars, and Venus. We seemed to know more of the Universe while seeing less of it. With the advancement of space technology. we might continue to know more of the Universe by installing observatories of various kinds in space. But we desire to know because we are in awe of the Universe because we can sense it, particularly because we see it. For us to remain in awe, we need to make sure we see the Universe as long as humankind exist.

Humans are not alone in relying on the Sun, the Moon and the stars. Animals, plants, and all those creatures too simple to be categorized as either, rely on the regularity of those celestial bodies and seasonal changes for their biological rhythm and communal dynamics. In fact, compared to us humans, they are far more sensitive to light, temperature, water and air quality, such that their well-being has been hugely compromised. In turn this results in natural imbalances of the world ecosystem.

At present I am not aware of any robust mathematical model that could predict DNA modification caused by the Anthropocene that is significant enough to warrant remarkable evolution in the feature and behaviour of all earthlings. In any case these changes would likely be ingrained as the cause of the change is forced by the activity of the ever-growing human population and by the complex interrelations in the earth ecosystem. We never allow our home planet to breathe, rest, and restore. Thus, unlike natural catastrophes such as volcano eruption, tsunami, meteor impact, hurricane, which are spatially and temporally localized, the effect of human activity is global and perpetual.

Human like to reflect and have learned the benefit of doing so; supposedly a distinct mark of intelligence. What we choose to be the mirrors are necessarily objects or phenomena outside of ourselves. We know our personality better due to our interaction with family, friends, and even strangers; we know our anatomy and physical function since we learned of the same in animals; we understand our Earth better as we examined our sibling planets; we comprehend the nuclear energy supporting the life of our Sun after we learned the spectra of myriad of stars in our home Galaxy; we accept how mundane or how special we are upon reflecting on the whole Universe. We cannot know ourselves completely unless we expand the learning scope beyond ourselves; a simplistic interpretation of Gödel's theorem which has been the soul of astronomers.

### **Note of Hope**

Today's trend in applying Science Technology Engineering Arts Mathematics (STEAM) education among conscientious groups of world citizens paves the way to restoring humans privileged position on Earth: as wise steward. We also witness the current movement of citizen scientists who produce not only a good quantity of good quality science, but a growing number of people who understand, and respect, the working of nature. In the meantime, many multidisciplinary topics raise the interest of people otherwise separated into irrelevant branches of science; they now work together for a common cause. A beautiful illustration for this is the application method used in pattern recognition of HST images on sharks' skin. This has made individual identification of the shark community members possible. This in turn allows further detailed behavioural study yielding invaluable insights on marine biology. For us humans, this exercise opens way to multitude perspectives which might construct and enrich a new and better vision, and therefore a better attitude towards the world. The only Home we know so far.