ScienceArt Commune 1: Whirling with Waters

Alliance Art-Science 1 : Tourbillonner avec les Eaux

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RÉSUMÉ. La plupart des dinoflagellés ont des cycles de vie complexes (figures 5, 12), comprenant des cellules d'essaims libres, des formes coccoïdes non mobiles et des kystes au repos (figure 24,25). De nombreuses espèces présentent une bioluminescence (« larmes bleues » figures 15-19) et une toxicité concomitante qui peut s'accumuler tout au long de la chaîne alimentaire et se manifester par des syndromes d'intoxication humaine par les mollusques (Note 2). La plupart des formes libres sont mixotrophes, avec la capacité de photosynthèse et de collecte de nourriture à partir de la lumière. Les dinoflagellés symbiotiques forment une relation symbiotique avec les coraux ; l'arrêt des opérations bidirectionnelles entraînera le blanchissement des coraux (figures 11-14) et la disparition de nos écosystèmes de récifs coralliens. Les cellules de l'essaim de dinoflagellés ont des flagelles avec un mouvement tourbillonnant (grec = *dino*) (figures 1-4), et peuvent effectuer une migration verticale entre différents plans d'eau pour accéder à une meilleure parcelle de nutriments. De nombreuses espèces sont contre-intuitivement sensibles aux turbulences et ont tendance à s'agglomérer dans les eaux stagnantes, ou comme dans le cas des dinoflagellés symbiotiques, à l'intérieur de leurs hôtes coralliens habituels. Les vastes mers de « proliférations » de dinoflagellés se terminent souvent par des eaux peu profondes ou se transforment en kystes « au repos » qui coulent dans les sédiments benthiques et attendent un meilleur moment ; l'expérience de la vie, de la prolifération et du kyste des dinoflagellés est adoptée comme scénario dans cette « communion art-science. » Le thème principal étant le soi-même et *Adieu ma concubine* (figure 6). Les individus d'une prolifération, malgré les apparences, ne sont pas les mêmes, car les différentes parties du plan d'eau sont différentes. Certains sont plus près de la surface avec une irradiation et exposition, d'autres sont masqués par la prolifération et font face au benthique avec une condition anaérobie potentielle. La ou les moyennes mobiles sont composées de différents sois, les images exercées et préceptées de soi, peut-être photo-acclimatées et changeant de composition photopigmentaire. Adieu con~combiner les différentes étapes du cycle de vie, ce sont tous les mêmes dinoflagellés, avec des épigénétiques et des transcriptomes différents.

ABSTRACT. Most dinoflagellates have complex life cycles (figures 5, 12), comprising free swarmer cells, non-mobile coccoid forms, and resting cysts (figures 24,25). Many species exhibit bioluminescence ('blue tears' figures 15-19) and may produce toxins that accumulate through the food chain, manifesting as shellfish poisoning syndromes (Note 2). Most free-living forms are mixotrophic, with capacity of photosynthesis and obtaining nutrients from their environment. Symbiotic dinoflagellates form a symbiotic relationship with corals; cessation of the two-way operatives will lead to coral bleaching (figures 11-14), and demise of our coral reef ecosystems. The dinoflagellate swarmer cells have two flagella which perform a whirling movement (Greek = *dino*) (figures 1-4), enabling them to conduct vertical migration between different water bodies to access better nutrient patches. Many species are counter-intuitively sensitive to turbulence, and tend to aggregate in stagnant water, or as in the case of symbiotic dinoflagellates habituated inside their coral hosts. Vast 'blooms' of dinoflagellates often end as waters shallow, or they transform into 'resting' cysts that sink to benthic sediments to await more favourable conditions. This bloom-to-cyst life cycle is adopted as the storyline in this ScienceArt Commune, focusing on the concept of 'self-one' and 'farewell my concubine' (figure 6). Individuals within a bloom (Figure 18), despite appearances, are not identical, as different parts within the water body is different. Some cells are closer to the surface with higher irradiance and exposure, while others are screened by the bloom and face potential anaerobic conditions near the bottom. The moving average(s) are composed of different self-ones, as well as perceived self-images, perhaps photo-acclimatised and changing in photopigment composition. Fare-well con~combine the different life cycle stages, they are all the same dinoflagellates, with different epigenetics and transcriptomes.

MOTS-CLÉS. ScienceArt, communication scientifique tertiaire, science inclusive, dinoflagellés, cycles de vie, soi-même, adieu ma concubine, SciArt, Science and Arts.

KEYWORDS. ScienceArt, tertiary science communications, inclusive science, dinoflagellates, life cycles, self-ones, farewell my concubine, SciArt, Science and Arts.

1. ScienceArt Permeation

Both science and art are acts of human creativity increasingly recognized as fundamental pillars of our knowledge-based societies. Both will play essential roles in the advancement of humanity, especially with the advent of climate change, food insecurity, and bio-insecurity – their fusion and resonance will become increasingly important. Arts and Sciences are concerned with creative questioning, interpretation and expression of our understandings through models. Both art and scienctific institutions require the behold of traditions, while also embracing nonconforming, innovations, and paradigm shifts. Increasingly, decisions are made in the context of sciences by non-scientists; basic science needs to address its sustainability issues, especially considering the time lag between discovery and technological applications. Scientific knowledge has accumulated rapidly in the last half century, often alienating the public from the details of advancements. Fostering creative processes, very often when different fields collide/intersect, in this case science and arts in a double reflection at high levels, is important but challenging to integrate into modern educational curricula. Science-Art communications should aim not only to enhance public understanding of basic sciences but also to foster an appreciation of the creative process itself, especially empirical thinking from fundamental principles. I propose, with this example "*Whirling with Waters*", a focus field orientated ScienceArt Commune, an integrated platform featuring multimedia arts, scientific narratives, as well as science and technology demonstrations. This represents an advocacy for more inclusive science communication, complementing important science extensions at primary and secondary levels. The ScienceArt Commune represents a new artform and a coherent form of science communication, fostering more focused paradigms, potentially harnessed with scientific society meetings, as well as all tertiary levels.

2. Dinoflagellate introduction

Dinoflagellates, infamous for forming intense bloom[1], are single-celled aquatic organisms found in most aquatic ecosystems. They function as both primary or secondary producers, participating in the microbial loop that recycles dissolved organic matters to inorganic nutrients that can be utilized by other euphotic phytoplanktons that do not have mixotrophic capacity. In temperate seas, dinoflagellates blooms frequently occur after the Spring diatom blooms. They adapt by utilizing organic matter in addition to photosynthesis (hence mixotrophic), often responding to patchy nutrient distributions, including those from anthropogenic sources. This adaptation can lead to the discoloration of vast sea areas, forming red tides or harmful algal blooms.

Dinoflagellates aggregate in stagnant waters, for instance along a pycnocline[2] between two water bodies, at estuarine plumes, or within coastal wind-driven offshore upwelling systems. Some dinoflagellates form symbiotic relationships with cnidarians and other invertebrates, giving rise to spectacular coral reefs worldwide. There are approximately 2000-3000 species of dinoflagellates, with remarkable variation in forms and nutritional modes, and multiple instances of photosynthesis loss (Cooney et al 2024, Holt et al 2023, Janouškovec et al 2017). They are commonly micro-phytoplankton (>20 µm), with some at nanoplankton (2–20 µm) dimensions.

Algae (a common lesser-used Latin word) are phylogenetically diverse; dinoflagellates are a sister group to Apicomplexa, which include the malaria parasites, and ciliates (Gould et al 2006), which include the *Paramecium* sp., with further phylogenetic distance to other algae (for instance brown and red algae). The tandem repeats encoding of many dinoflagellate genes (Beauchemin et al 2012, Lin 2011), some with proven infraspecific variation (Stephens et al 2020), likely harbours sufficient genetic variability commonly believed to engage biological fitness. With up to thousands of copies per gene, for instance of luciferin-binding protein in bioluminescent dinoflagellates (Valiadi & Iglesias-Rodriguez 2014), the 'moving average' of individualism as a gene assemblage defies computation estimates. The possible permutations of self, incorporating past "concubine fare-welled" (pseudogenes), perhaps explain their high resilience to extreme doses of ultraviolet C irradiation (Kwok et al 2022).

[1] https://www.afcd.gov.hk/english/fisheries/hkredtide/redtide.html, https://www2.whoi.edu/site/andersonlab/

[2] Pycnocline: A layer of water with steep salinity change, often within two water bodies

Figure 1A. *Whirling With The Flow Painting 1 (120 x 35 cm, ink-color on paper, 2023)*
Artist concept 1: blue water coming and going, along with yellow moon(s) and red sun.
See the art concept in Figure 1bTwo moons in 24 hours. The turns (orange) interlude with forward troughs (blue); the sun (red) intermittent with two moons (yellow). Artistic concept 2: The flash (gold) was drawn amongst the fish dorsal fin with binary-like codes, with caudal fin out field. (fish head on the left)

Unlike other phytoplanktons that are passively flowing, many dinoflagellates perform diurnal migration through water layers, accessing nutrients from deeper layers and photosynthesizing in upper layers during the day. Dinoflagellate swarmer cells have two flagella, enabling them to conduct the distinctive whirling in waters.

ArtScience: Dinoflagellate swarmer cell has a circumpolar ribbon-like flagellum and a vertical longitudinal flagellum, the circular movement of both resulting in the turning of the cell as well as a forward movement. The circadian propensity of bioluminescence activation was likely attributed to nascent time-lag in photosynthetic build-up. Under stress (agitation) many thecate dinoflagellates undergone ecdysis, involving the whole amphiesmal shedding; this shares many signalling pathways with scintillans activation as both are mechanical sensitive. This resource demanding process, which allows the cell to evade unfavourable conditions, cannot be perpetually re-executed. Bioluminescence may have offered the cell an alternative 'exit' from the program, the ecophysiology of which will be intertwined with the conversion to G0 state required for resting cyst.

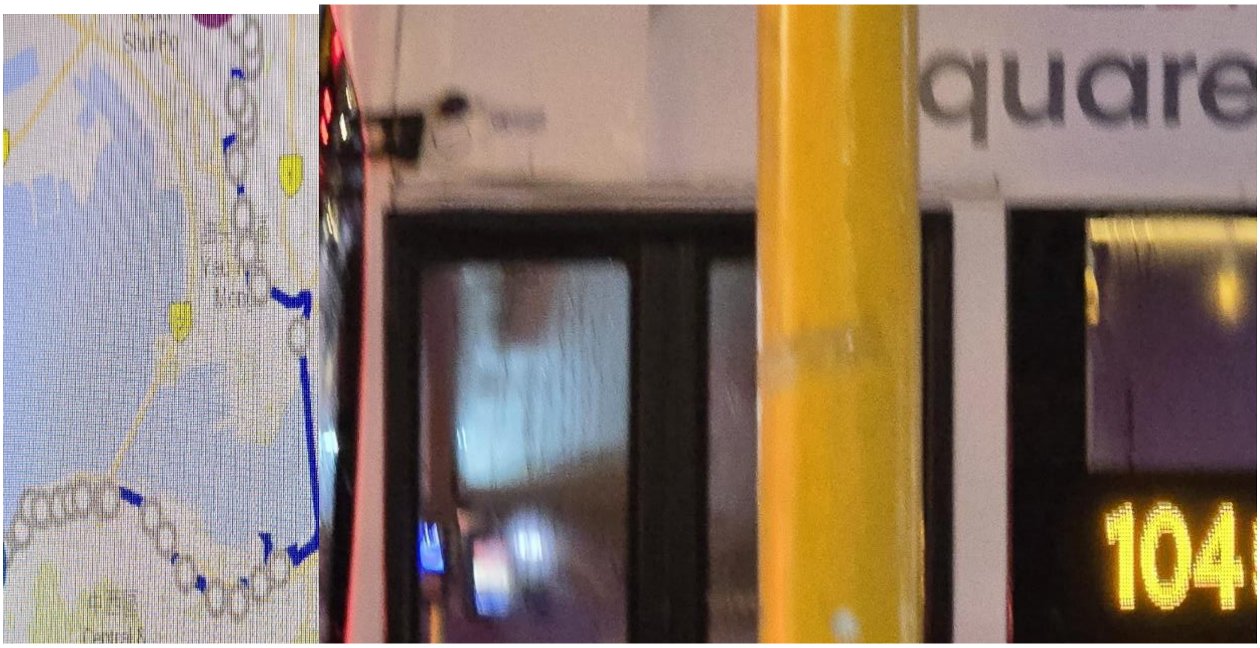


Figure 1B. 1 to 2^2. *(original photo) The realization of me to non-me(s) further to the dragging-along feeling, the reciprocal feeling, and the plurality in reciprocal me-images Is the internet provisioning that handles?*

The 104 is a cross-harbour bus route rendezvous at the Pak Tin Public Transport Interchange (White Field).
In a bloom of unicellular organisms, there are many allelochemicals, through secretion or through cell lysis. For instance, the bacterial molecule indole regulates various aspects of bacterial physiology, including spore formation, plasmid stability, resistance to drugs, biofilm formation, and virulence

Figure 2. *Whirling with Water, DriftWoodCutCraft, Natural Drift-bamboo root with Molluscan borer floatWood ~50 cm (2022), Borer holes are clearly seen. Oil-Cleaned unstained abalone shells with copper patina*
Dino (Greek = whirling)
Dinoflagellates move forward through whirling, with action by the lateral and horizontal flagella

Figure 3. *Whirling Tenacity of Engagement (Painting 2 ink and color on paper, ~ 35cm x 70 cm. 2023)*
Art Concept1: unlike most other phytoplanktons, many dinoflagellates conduct diurnal vertical up-down migration, seeking for a better patch of nutrients. Artistic concept 2: The ant face with two antennas (orange). Pheromone signaling for tracing food. The soldiers, the workers, and the queen
Optimum Foraging Theory covering proportion of foraging effort and gain
(Hughes 1980, Tyson et al 2016)

Assuming fair competition with unlimiting resources, e.g. fair exchange rates to commodities
Chinese characters for human (人) and enter (入) and eight (八), The flow depicted in two 'eight(s)' with alternate left-right hands in free style of swimming (Figure 2,4)
Blue and orange are respectively penultimate to the normal spectrum of colours, the moving average with black and white normally excluded
Optimum Foraging Theory ASSUME
no slavery, colonization and controlled exchange rates
In the last half a century, average life expectancy rise, with general reduction of illiteracy.
"Mostly" fulfilling basic needs except ~828 (https://doi.org/10.4060/cc6550en) millions

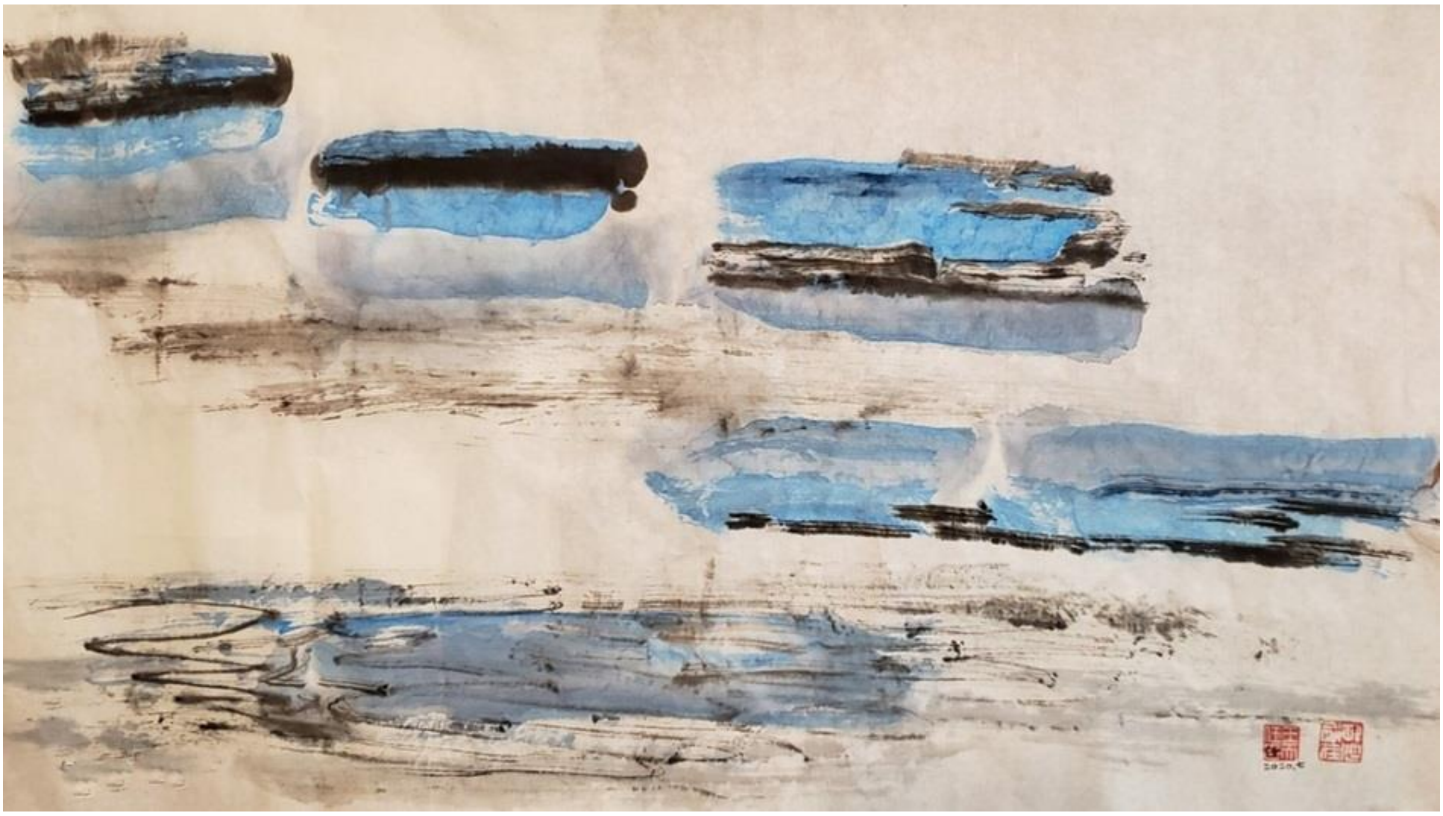


Figure 4. *Whirling With Waters - A Good Run (Painting 3, 102 x 62 cm, ink-color on paper, 2021)*
Art Concept 1: four seasons (the black line going downwards) and the year turning, the importance of frost in the following year's agricultural production.
Concept 2: the four seasons in life: child, youth, mid-age to old age, amid extension of life expectancy. The front flaw (3rd -4th stage autumn), did it make a minute edge to the flow?? from parental influence per education and experiences (summer dew) to perhaps finding your direction (autumn), notwithstanding the rhyme of winter (with retrospectives). During the turn of each new year, it is believed that the legendary monster 'Nian' (年 = year) must be driven away for good fortune. Retrospection is a distinct human trait that enables us to build on prior experiences. Our continuous exploration of the past in prospecting for future
Science Concept: Many species can form dense bloom (10^3 cells/ml), going through initiation, proliferation, aggregation, and further aggregation with water movement. Algal blooms disappear with waves and water dispersal. *art credit: http://www.yshk-art.com/pithy-detail-2872.html*

3. Bloom and cysts through life-cycle transitions

Life cycle transitions (LSTs, see Fig. 2) are common operations in many protists. Dinoflagellates form "resting cysts" through sexual reproduction that allow them to overwinter or survive unfavorable conditions for extended periods. The dinoflagellate amphiesma (commonly referred to as the cell wall) and its cortical membrane organelle with polysaccharide specializations are remodeled during different stages of their life cycles. The most common remodeling process involves transformation into a resting cyst with special polymers (dinosporin) that are resistant to harsh environmental conditions (Bogus et al 2012), allowing the population to 'over-winter'. Cysts will germinate to form new blooms when the conditions become favorable. Some dinoflagellates exhibit more complex life cycle transitions. For instance, the phantom dinoflagellate *Pfiesteria* sp. can form an amoeboid stage and pass through the host (a fish) body, causing hemorrhaging. Many dinoflagellates can also form 'ecdysal cyst' within minutes of stressful environment and regenerate the cellulosic thecal plates immediately without transforming to resting cysts (Kwok *et al* 2023a, Kwok *et al* 2023b).

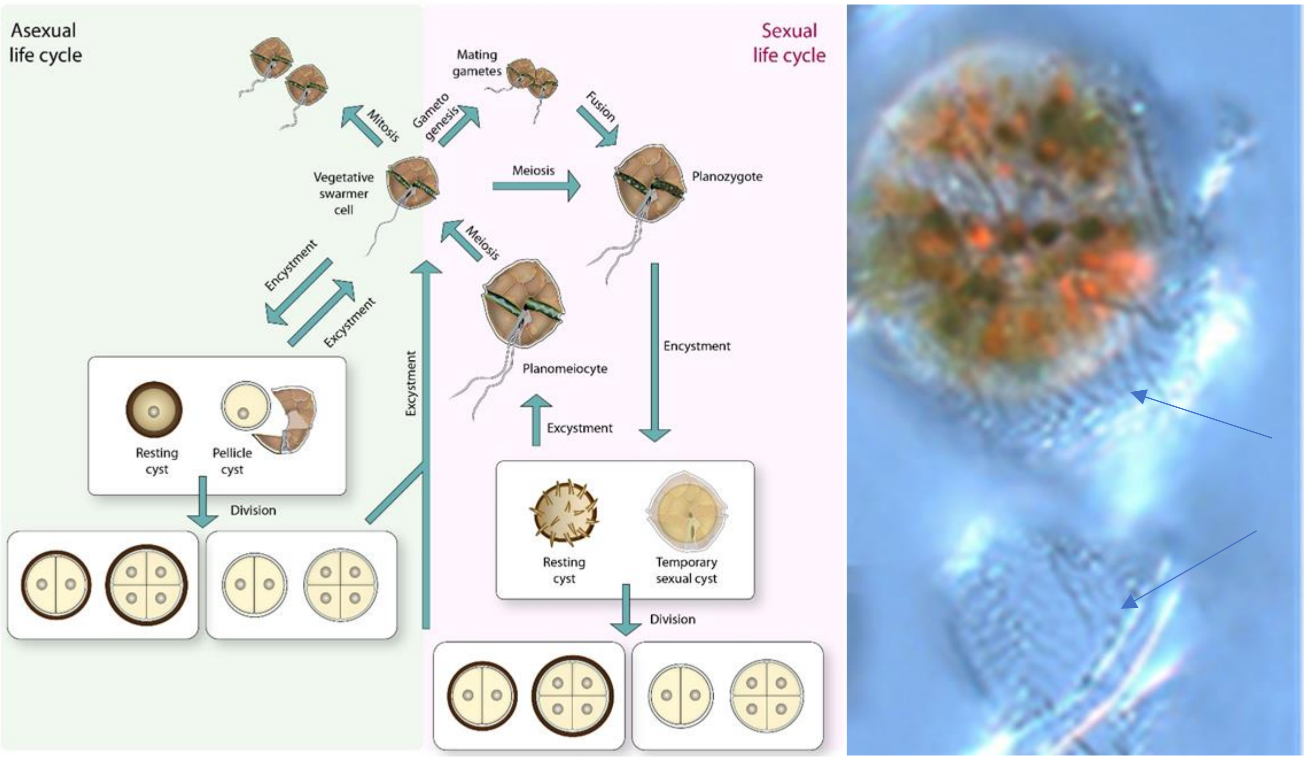


Figure 4. *Life Cycle Transitions are keys to dinoflagellate ecological phenomena*
Blooming is not only cell proliferation, but also cell aggregation with water flow and stagnation. The transition from motile to non-motile stages is important in algal bloom dynamics, coral re-'infection' with symbionts and parasitic dinoflagellates (e.g. of oysters) in transmission.(Diaz & Figueroa 2023, Wong & Kwok 2005)
(Photomicrographs: photosynthetic Lingulodinium polyedra with cellulosic thecal plates (arrows,) shed during ecdysis, swarmer cell stage ~20-30 µm; L. polyedra cells are bioluminescent
Symbiotic dinoflagellates are in coccoidal stage in hospice, and many invertebrate hosts can take up the swarmer cells selectively, the mechanism of which is not fully known.
Diagrammatic illustration by Dr. Alvin C.M. Kwok (HKUST)
Please refer to figure 16 for cyst formation and symbiotic dinoflagellate life cycle figure 11.

Figure 6. *Obsession with One-Selfs: Farewell my concubines*
DriftWoodCraft1 (~ 40 x 15 cm) Float Tree trunk-root, natural incorporated black pebble, With copper pipe patina crafted to a self-obsession poise.
With one cell, unicellular organisms have to make do to face the elements, with some of the harshest environments. Imagine the intertidal zone, changing from freshwater rain to seawater in high tide, from snow in winter to dessication during spring low tide. Their cell walls are their armour, but without the body mass to capacitance changes in thermal regime. There are multiple life-cycle transition states in dinoflagellates, with up to 24 being reported for the phantom dinoflagellate Pfiesteria sp., from free-living to amoeboid inside the fish host during the parasitic stage. The concubine was me, farewell.
Encompassing from One to Self, and to an outside-mirrored Self. The opera legendary story ‘Farewell my concubine’ storyline with the post-Chin dynasty fight between the future Han (汉) emporer Liu and the King of the Chu State (楚国), with the final battle famously encircled with “Chu’ songs (by the Han army) to remind them of homesick and fore-giving the will to fight. The King, a reknown general, fought to the last person.

NOTE 1 All artworks in the subchapter *Farewell my concubines* is in celebration of Leslie Cheung’s Performance in *Farewell My Concubine*, awarded The Palme d'Or at the 1993 Cannes Film Festival.

The top piece (copper pipe patina) was designed to dorsal-ventral pathway of the brain, Awareness is modelled on balance between neural circuitry, encompassing consciousness, subconsciousness and sleep (with or without dreams) which is an important part of memory consolidation that provision refraction.

Brown RE, Basheer R, McKenna JT, Strecker RE, McCarley RW. Control of sleep and wakefulness. Physiol Rev. 2012;92(3):1087-187.

The self-obsessor poise of hugging one’s back, with sprinkle of green in the wood centre with strong green patina.

In obsession with which self?? The subconsious ?

Also in the Helicity of Life subchapter. The double-strand DNAs, with primary gene-encoding information, are transcribed into single strand RNAs, commonly with secondary structures. In vivo, many molecular processes are conducted by a composite of DNA-RNA hybrids (R-loop), as in the case of minicircles (Howe et al 2008, Zhang et al 1999).

Amongst gene locations in lifeforms, the most demanding has to be chloroplast genomes that engage with harsh conditions of the photosynthetic organelle, with high redox fluxes to perform ‘splitting of water’ for carbon fixation on earth. Most chloroplasts have genome sizes up to 200kb, encoding almost full complements of essential proteins of the photosynthetic organelle. Most of the dinoflagellate chloroplast genomes migrated to the nuclear genome during evolution, but not the mitochondria genome that may harbor over 300kb organelle genome(Shoguchi et al 2015), with less than twenty genes being encoded in single gene minicircles with only 2kb each. The most prominent being the psbA gene encoding the key protein in photo-system II, which exhibits high dynamics with photodamage and repair. These wonders suggested all the information concerning the transcription, replication and expression of those important photosynthetic genes are all encrypted within each minicircle (Kwok et al 2023c).

IF there were a human guidebook 101, how should we formulate self-image roles in solicity.

Behold the One and Self in a bloom, others are con~combine

Figure 7. *Homeostasis with Self:Con~Combine*
Fried egg photo compilation, the left is the flip from the original; the right panel is in original form.
No photo adjustments in exposure nor color.
The left, obviously with passage, exhibiting a rhyme with the jocker in life. The younger right is full of hope.
The moving average is part of the mission. An egg can be life or death for a starving person, cholesterol or not.
There is no introductory 101 class in life; in our journey of encountering, many pay too much attention of how we are percepted by others, superimposing a reflected self, prior to the self, all have been me.
Butter-flyging One Dream

Part of the subchapter *Farewell my concubines.*

Figure 8. *One in Self-Transitions: (2^2)? Painting3: (~70 x 90 cm Ink and color on paper) ArtScience Concept: Life cycle transition in dinoflagellates (Figure 5) Imagine if we were transforming as a protist through the various life cycle stages, all within the one cell. We transform through physiological and psychological maturation; how would the human 101 guidebook have said? after 1 to 2^2 (2^2). 2, seeking 2^0 again will require fostered interactomes*

Part of the *Farewell my concubines* subchapter.

My interpretation of 8 steps (八步) rhyme with the commonly phonographic as the eight clans (八部) that protect the Buddha (sanskrit अष्टसेना，Aṣṭasenā) ; (天龍八部) the chinese literally meant 'eight clans of the skying dragon' See Figure 9 Looking back i(n square box), retrospective, and learning from our mistakes are genuine human traits that have helped not only in arts and in sciences, but our perseverance.

Figure 9a. *Quorum With Engagement, DriftWoodCraft2 (~100 x 20cm), In addition to sexual cysts, dinoflagellates also undergone temporal cyst formation, allowing individuals to evade unfavourable conditions (Kwok et al 2023b).*

We are now having more choices to change jobs and residency in our life experiences. Media Concept: floatwoods (with barnacles), fungal sporocyst (mushroom) infected piece for the bow, scent float wood base.

The saprophytic nature signifies despite our limited lifespan, humanity prevails

with considerations of future whom.

Three copper rings of the arrow. Both wood pieces accommodated nascent barnacles, capturing the moment before microbial degradation.

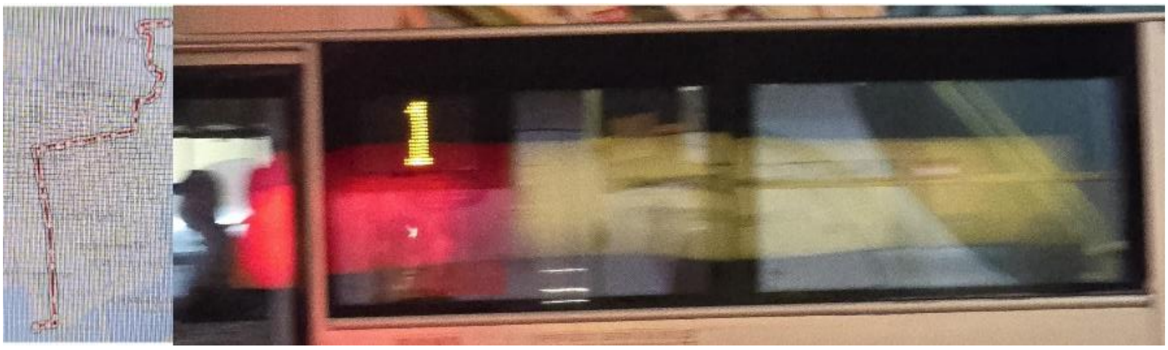


Figure 9b. *The No.1 Bus (original photo compilation) go through the whole Kowloon Peninsula. Dinoflagellates rarely aim to habituate alone, whether in pelagic, or in interstitials amongst sands; they hatch in numbers, from benthic cysts, from hosting fishes, or from other dinoflagellates. THEY catch the moment to make a difference. from the Chuk Yuen Estate (Cantonese phonographically "bamboo circle=adequacy") to Tsimshatsui ('the pointed end') Star Ferry station, going through amongst other stations is Morse Park. as depicted route apparent the legendary 'one-legged self' ('woo'夔)*

(ideographically 'flower this is me in my obituary')

From 2 to 1 (^{o}C) again, passing through red and yellow, hopefully seeing green.

Every(one) counts in climate change engagement. Perhaps the morse law approached its margin

Product lifespans rather than unwanted performance (The seemingly funeral car-like presentation)

Of cumulolim~bus and lim~bus

With climate change, arts and science will be needed to help us to go through uncertainties,

Including uncertainty in climate modeling (Stainforth 2023) and amongst the individual us on the same bus

La Salle Road, where my alma mater primary is located, is amongst one of the stops of No.1 route.

Figure 10. *Modular Self: One by-of Whom (Painting 4. 85x85cm, Acrylic paint-ink-color on paper)*
Art Concept: Perceived image (the distance blue sun) whether by self or via others' comments, and it takes time to reconcile. See figure 16 and 17. The eight dragons of my personal Aṣṭasenā.
Dragon Color codes green (without head, bidirectionally two dragons): my youth; orange: my tenacity, especially dealing with uncertainties; gold; resource needs biting into my time, blue: my society and black: my turf; white: life expectancy, dark purple reservoir, my parental influence (esp. maternal)

ArtScience: Most dinoflagellates are mixotrophic, having the capability to conduct photosynthesis and heterotrophy. A unicell grows with dependence on founder effect, the prevailing growth conditions (concordance with the lag-log-diapause-stationary phases within a population), the call for metamorphosis into another life-cycle stage, and the perceived resource availability. A metazoan cell perceives growth messages through hormonal control.

Part of the chapter. On Cellular Growth and Genome Cycles: San sugre san profane(laie)

The orange dragon also looks back, with gold dragon eyes.

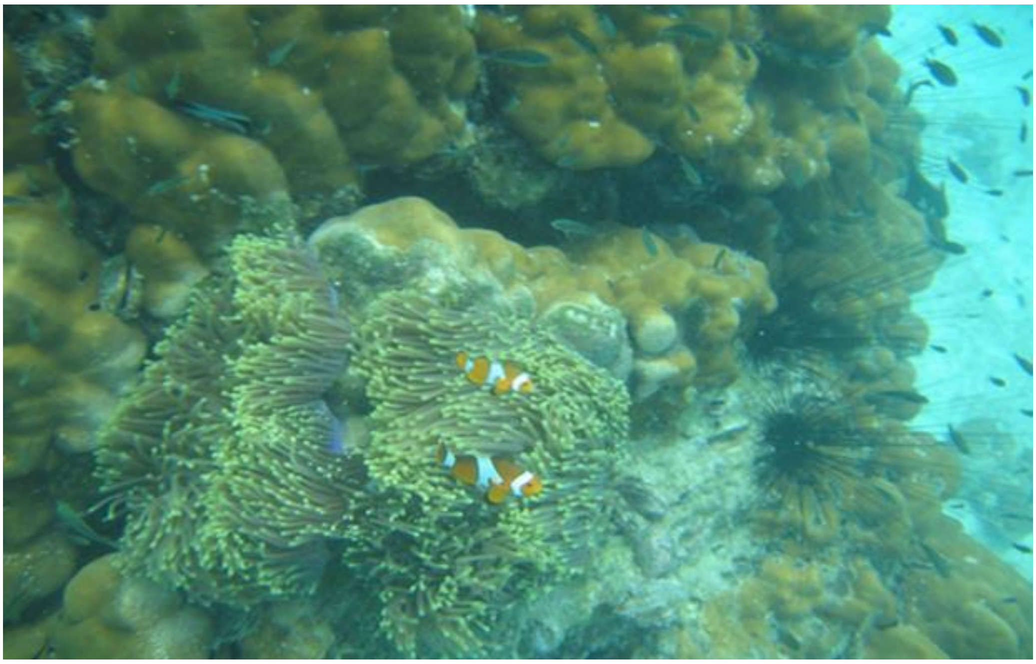


Figure 11. *An underwater photograph taken in Port Shelter non-reefal environment (opposite to HKUST) (circa 1995, Olympus Tough). The flower sermon, 'For Whom it is for?" See figure 19 and 20 showing corals in the background, and two long-spine sea urchins*

Two sea anemones, marked by two anemone fishes, also contain symbiotic dinoflagellates, as in the coral in the background. Despite Hong Kong waters are in the subtropic, close to freshwater runoff from the Pearl River, there is a substantial diversity of corals and marine life that habituates amongst the non-reefal environment.

Symbiotism of Symbiodiniaceae-cnidarian that form the basis of coral reefs, harboring some of the most spectacular ecosystems on earth with the greatest biodiversity. Anemone fishes are often protandrous hermaphrodites, with largest male transforming to the dominant female

4. Symbiotic Dinoflagellates

Dinoflagellates of the Order Symbiodiniaceae form symbiotic relationships with many invertebrates, including corals. Within coral cells, symbiotic dinoflagellates, also known as zooxanthellae, reside in highly acidic compartments called "symbiosomes" within the gastrodermis cells. These symbiosomes are believed to be modified phagosomes of the host.The symbiosome pH plays a crucial regulatory roles in the transport between the host and the zooxanthellae, as well as in the symbiont vesicular transport. While the host benefits from the photosynthetic products of the symbionts, it is less clear what the zooxanthellae receive in return, apart from housing and nutrients in an otherwise nutrient-poor tropical oligotrophic waters. Recent investigations suggest that a specialized molecular transport channel may be responsible for transferring ammonia (a nutrient) and CO_2 into the symbiosome [4], which is crucial for maintaining mutual benefits. The acquisition of symbiotic dinoflagellates by the host can occur through two main routes: vertically through eggs, or horizontally from the environment, with the specific mechanism depending on the species involved. The genomes of free-living dinoflagellates can reach up to ~200Gb, when compared to the 1Gb genome in coral zooxanthellae (Shoguchi et al 2013).

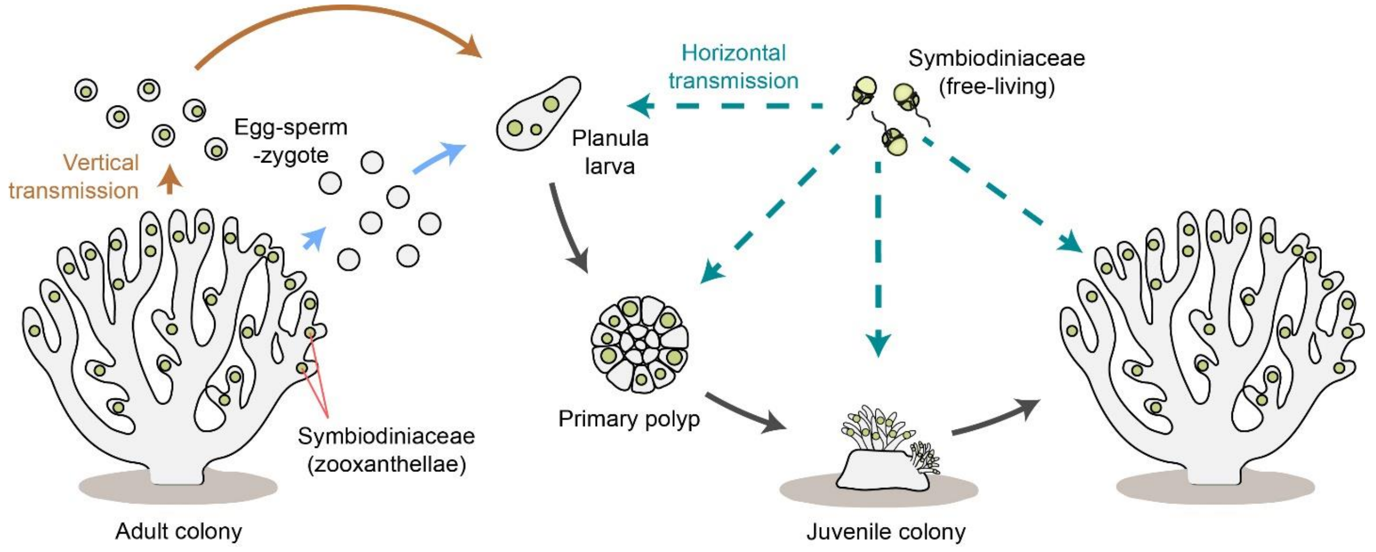
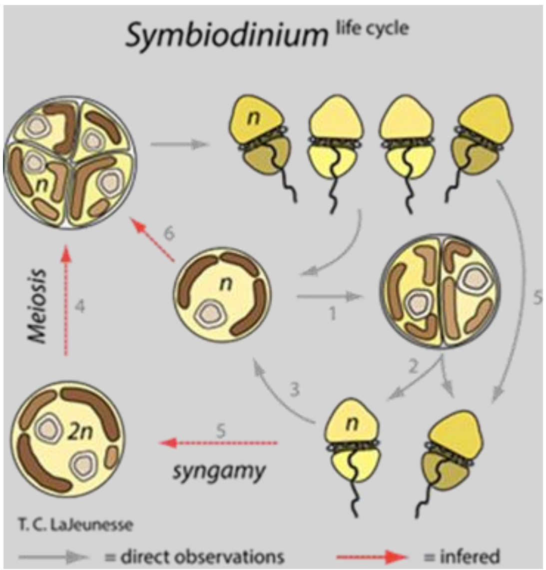


Figure 11. *Coral-Dinoflagellate symbiotism*

A. *The vertical and horizontal transfer of symbiotic dinoflagellates with coral hosts (diagrammatic illustration by Dr. Alvin C.M. Kwok)*

Non-symbiotic dinoflagellates could be rejected by the cnidarian host at the larval stage (Jacobovitz et al 2021)



B. *Symbiodinium Life Cycle by Allisonmlewis from https://en.wikipedia.org/wiki/Symbiodinium, under a Creative Commons CC-BY-SA-4.0 license*

Dinoflagellates of the Order Symbiodiniaceae formed symbiotic relationships with many invertebrates, including coral. This relationship is the basis of all coral reef ecosystems, providing mutual benefits. However, the balance of the symbiotic relationship broke down, with the advent of climate change. Once the coral gives up their symbionts, it is difficult to recover. As coral white calcium carbonate exoskeletons are exposed (coral bleaching), the surface will be quickly covered by other opportunistic organisms. There are free-living cells termed "mastigote" stage, which have flagella, in contrast to the npn-flagellated coccoidal stage inside the host. Some hosts reacquire symbionts during the larval stage, whereas some are passaged. It remains controversial if coral symbionts have sexual life cycles.

Figure 13. *Two-Way Operatives*

(Float wood craft 3. ~ W 20 x H 25 x L35 cm, with marine wood borer holes, the top piece was connected to the bottom piece with a copper patina tube, symbolizing the passage of photosynthetic products to the host from the zooxanthellae, the inverse tree branch has two rings, signifying the two-way relationship)

Science narratives shared with figure 9. We have yet to fully appreciate the mutualism between corals and their symbionts, including how the host 'regulates' quality and quantity of zooxanthellae.

Is there anything else apart from 'in sickness and in health' ?

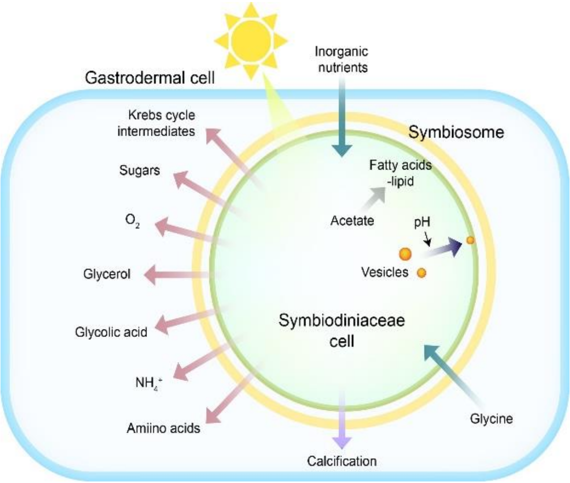


Figure 14a. *Diagrammatic illustration of selective flow of nutrients and biomolecules between symbiont and coral host. How the dinoflagellate enhances host calcification is not fully understood.*

(by Dr. Alvin C.M. Kwok) drawn with published data from different papers

Figure 14b. *The Subjectivity in Objectivity: Take Twos to Tangle, and Waltz (Painting 5 ink and color on paper ~ 45 x 85cm) Art Concept: Duality in relationships ArtScience concept: Color chromicity in color. TA (thymine-adenosine) steps with GC (guanine-cytosine) content, the propensity of dsDNA melting, TACG being the four bases forming the genetic codes The 5th base in dinoflagellates(Rae 1973) (grey color left box) 5-hydroxymethyluracil replaces up to 60-70% of thymine*

5. Dinoflagellate Bioluminescence

Bioluminescence is a type of chemiluminescence, light produced by a chemical reaction, which unlike fluorescence that required another light excitation (Anaël et al 2024), is produced by live forms. *Noctiluca scintillans* (left, ~500-1000µm) is now a global species, the green and the red variety depends on the pigment of the algae the large dinoflagellate (1mm) feed on. These heterotrophic dinoflagellates, which normally prey on smaller phytoplanktons, are very often responsive to eutrophication. There is a photosynthetic *N. scintillans* that contains a green bacterial symbiont (Piontkovski et al 2021). Historically, dinoflagellates were referred to as the Pyrrophyta. Breaking waves are not a normal niche for the seaworthy. Many dinoflagellates generated intense bioluminescence that lit the shallow ocean, the redox dissipation within the cell wall allows them to transform to resting cysts, in preparation for a better time. Their obsession is for continuity, the self that is to come in ones. Please refer to ***Farewell my Concubine*** Figure 6 Craft 1. The functions of bioluminescence were proposed to involve 'burglar' alarm and redox dissipation.

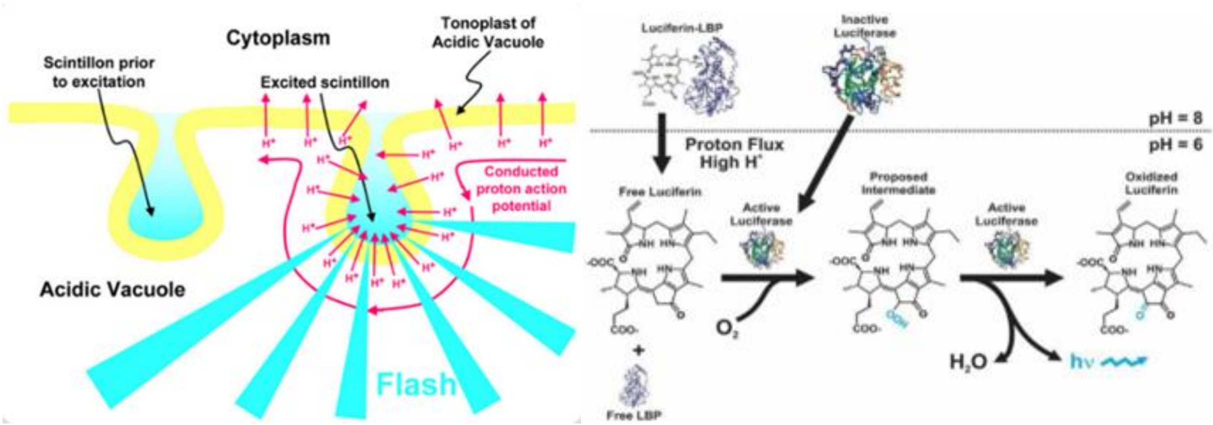
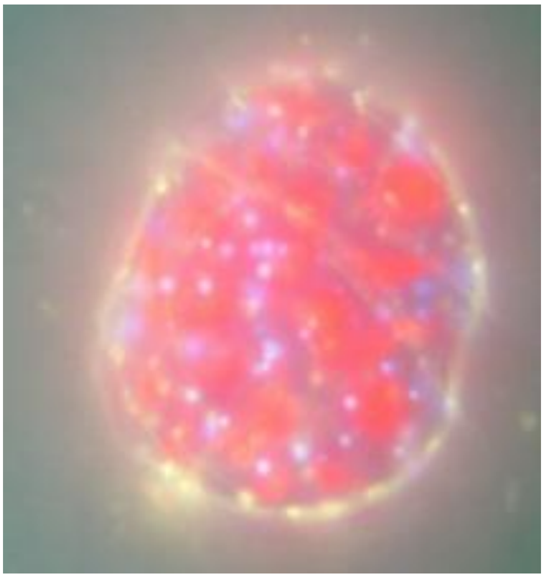


Figure 15. *Cortical organelles called scintillans are the production sites of dinoflagellate bioluminescence* **Left.** *Schematic representation of part of a dinoflagellate cell, depicting the cellular processes that take to generate a bioluminescence flash. From (Valiadi & Iglesias-Rodriguez 2013) https://www.mdpi.com/2076-2607/1/1/3 under a Creative commons CC-BY license.*
Right. *Bioluminescence model in dinoflagellates: the effect of pH on both LBP and LCF Adapted from (Fajardo Quiñones et al 2020) https://www.mdpi.com/1422-0067/21/5/1784 under a Creative commons CC-BY license.*



A fluorescence superimposed photomicrograph of bioluminescence (blue) with chloroplast autofluorescence (red) of Alexandrium catenella. (~25 µm).

According to (Valiadi & Iglesias-Rodriguez 2013) turbulence is perceived by a membrane receptor, modulating the membrane potential at the vacuolar membrane through Ca^{2+} signalling, which in turn activate voltage-gated proton channels. The acidification of scintillans with luciferase-luciferin-LBP with light emission (Valiadi & Iglesias-Rodriguez 2013, Valiadi & Iglesias-Rodriguez 2014). Different bioluminescent organisms deploy different types of enzymes and components. The dinoflagellate luciferin-luciferase are not the same as insect enzymes complexes biochemically, despite the same name (Kim et al 2012). Hence, beaming with different dreams.

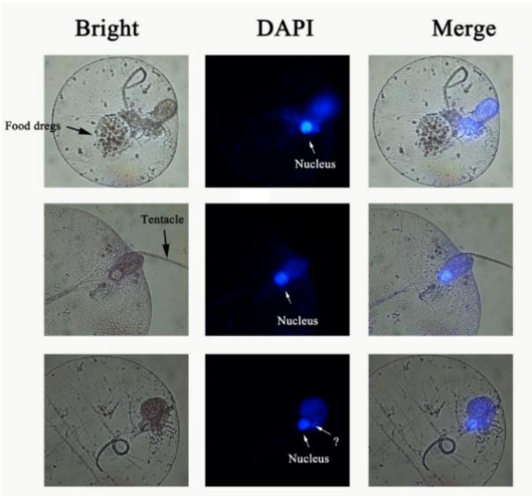
Figure 16. *Impermanence With Now per se*
Long exposure photographs at HKUST pier,
IV (Top right photograph) showing the ‘rusty’ color of Noctiluca scintillans patches during daytime.
N. scintillans blooms are now a global eutrophication problem, although they very often attract tourists for being the surreal ‘blue tears’ https://www.thestandard.com.hk/breaking-news/section/4/188074/%22Blue-tears%E2%80%9D-spotted-along-Sai-Kung-coast

Bioluminescence is a type of chemiluminescence

But unlike fluorescence (Jessus et al 2024), no

excitation light is required, generated by the cell.

The insert photomicrograph was that of two N. scintillans cells (Right) Light and fluorescent photomicrographs of DAPI (DNA dye) stained N. scintillans (taken by Shao Ping Wen), showing the nucleus, food vacuoles and tentacle. The large cell can be over 1mm in size, and is of the coccoidal stage, their sea surface niche is rarely shared by other microplanktons.



Most algal cultures are non-axenic, the bacteria holobiont scan be important for the dinoflagellate well-being. However, it may render molecular biology-biochemistry difficult to interpret as most analysis require cell lysis

NOTE3 Technology Point. Many fluorescent (need special incident light excitation) proteins are deployed for intercellular reporters to monitor subcellular locations of tagged fusion proteins (Anaël et al 2024).

Figure 17. *The Population Dimension: Beaming-Aspecting Different Dreams*
(Painting 6. Joypaint drawing)
The relatively unknown facet of bioluminescent population dynamics. The population is never uniform in relation to spatiotemporal incidences of bioluminescence. Are those blinking few calling for quorum from the rest, or vice versa.? 'A roof above my head' is the dream of many.
Cyst formation will be requiring complete changing of the cell wall (amphiesma),(see figure 24) synchronization of which will make a difference in forming bloom in the next season, without which alleochemicals will literally be a drop in the ocean.
(Dedicated the late Woodland Hastings, who pioneered many bioluminescence studies http://photobiology.info/Hastings.html)

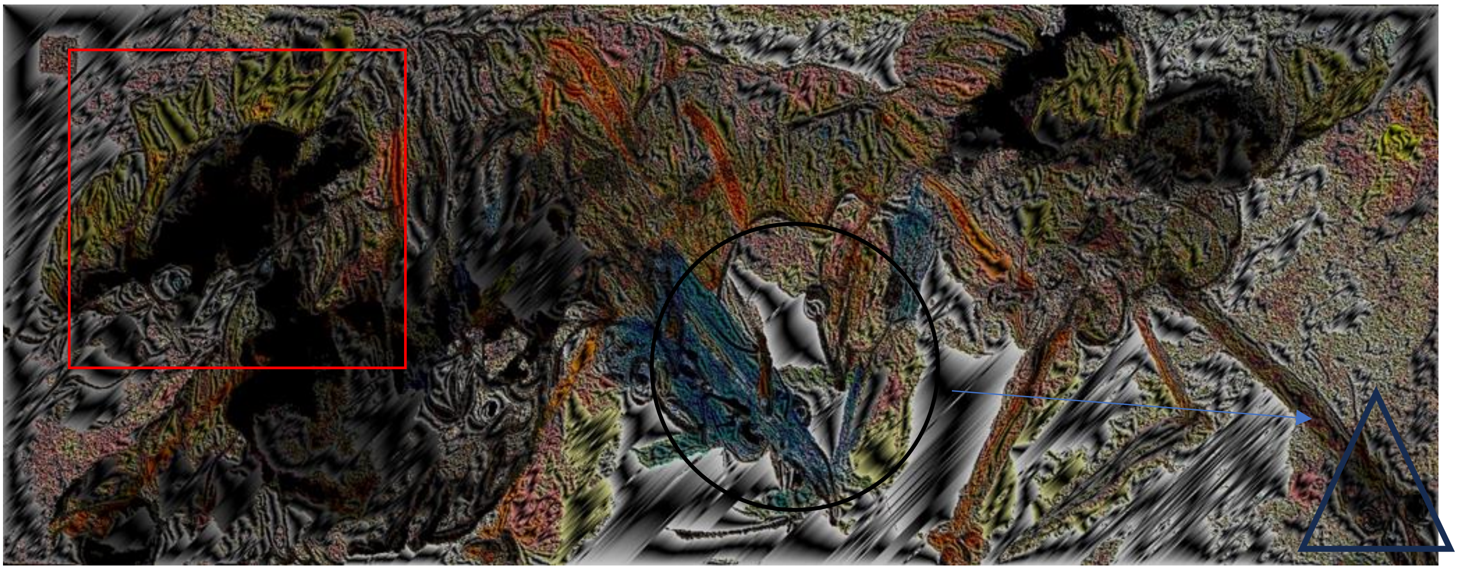


Figure 18. *Quorum for wHome*
('transformation of a Painting 7~ 35 x 80cm)
ScienceArt concept: dinoflagellate bioluminescence that lightens littorals forming 'blue tears'.

Forming of cysts and over-season need quorum to form, with synchronized hatching for a better time.

We propose the effects of bioluminescence result in synchronization of encystment processes.

ArtScience2: Resources are patchy in natural environment and most protists, unlike metazoan cells with hormonal signaling, evolved 'nutrients up-down shift' pathways for cellular growth concordance. The color differences stand for redox changes within a cell per biological processes.

See also Artistic concept of painting 2 and 8 (Figure 3 and 19).

(The art concept of the Chinese legendary fish Qun and the legendary bird Peng metamorphosis will be in the Chinese version of the ScienceArt commune)

Part of the *Farewell my concubines* subchapter.

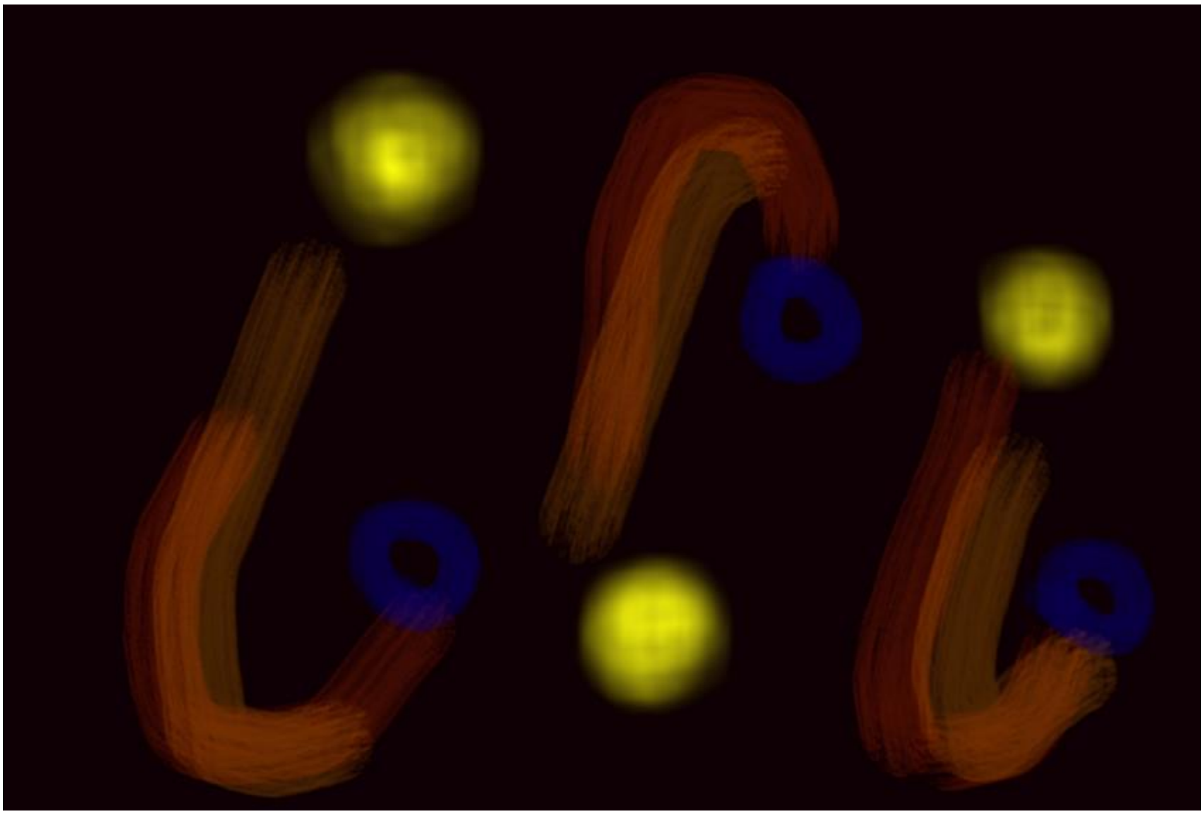


Figure 19. *Light ebb for light: 2^3 +1 (Painting 11. Joypaint drawing)*
Art Concept: The relativity of happiness-suffering; how many faces do you see ? which way ?
(perhaps we should ask the A.I.)
The 'real and 'false' footing, as well as 'Qi' feedback, in Tai Chi. https://www.wdgf.hk/
https://medium.com/@tresmancias-en/i-ching-in-tai-chi-chuan-7e1fc60bc6e9
ArtScience: Dinoflagellate bioluminescences exhibit circadian rhythm and photoinhibition
(Batchelder et al 1992, Hamman et al 2008)
The alternating light-dark with photosynthesis-respiration in the same cell, without let or hindrance. Quorum for the population. "So long, and thanks for all the energy" – the coming way.
Color codes: wood rings with seasons, shortening days from left to right 2^3 +1.
Percentage (%) reducing from R-L and increasing fomr R-L
There are three domains in dinoflagellate luciferase (Wilson & Hastings 2013)
There were also reports that bioluminescence being modulatedby the 'toxins' produced in the same cells
(refer to figure 9b)

NOTE2 Technology point : omega-3 DHA and bioactive compounds

A heterotrophic dinoflagellate from the genus Crypthecodiniaceae (Kwok et al 2023b) was used for industrial production of DHA omega-3 fatty acids that are supplements in infant formula. Without added DHA (and fish meal), most farmed fish (and chicken farming) will not be viable, and salmon won't have the orange color, but aquaculture is hailed as our solution for the pending food insecurity. Dinoflagellates are also producers of many bioactive compounds, including toxins that cause the Shellfish Poisoning syndromes (e.g. Ciguatera fish poisoning, Paralytic Shellfish Poisoning Syndromes; their toxins are accumulated in bivalves and when taken in sufficient dose, cause toxic syndrome in humans, commonly vomiting and diarrhea). Some toxins are indicated for disease treatment (e.g. cystic fibrous). https://www.mdpi.com/1660-3397/21/3/162

Figure 20. *Flower For wHome (~70 x 90cm, Ink-color painting 8)*

For many animals and plants, unlike their unicellular counterparts, their reproduction is synchronized through the seasons, with thermal and diurnal cycle regulation. For instance, all the oocytes within a batch are synchronized that gone through fast zygotic division upon external fertilization. In dinoflagellate, the unicell acts as its own gamete that fuses with another haploid, sometimes with hetero-mating types, to form a zygotic cell (Figure 5). In plants, fertilized ovums are endowed with substantial storage lipids and polysaccharides, in the specialized organ of flower-fruit transition.

The 'for' is probably answered by the Buddha's Flower sermon https://www.rzc.org/news/buddha-holds-up-a-flower/, which was explicitly forwarded by Louis Cha prologue

'For Whom the flower blooms? (問君三語, 為誰開 ?*)*

with referai to Zhao Zhou (chinese character 3) (Figure 22)

IN: Demi-Gods and Semi-Devils (天龍八部 sanskrit अष्टसेना · Aṣṭasenā) *prologue*

1963-66 by Louis CHA Leung-yung first appeared at Ming Pao Daily
http://www.yingyushijie.com/magazine/detail/id/2119/category/52.html

Do swarmer cells live for cysting? or-*and vice versa ? or for the copepod that happened to filter fed the dinoflagellate* ? *Some said it is the DNAs, selfish or not (Ridley 2016); or the genome with epigenetics ??*

Are infra- and intra-specific variations(Stephens et al 2020) 'for' the bloom ?? and vice versa

'The Sutra in Forty-Two Sections said by Buddha'

The 'All~mighty' in Douglas Adam.s 'Hitch Hiker Guide to Galaxy' *said '42'* '[$2^2$2] (For-ty-2)

('The Hitchhiker's Guide to the Galaxy Primary and Secondary Phases' (1978–1980) BBC Radio 4)

(*The chrysanthemum in a lotus pond.*) ((2^0) 2) x 2' x 2"

Figure 21. *Whom-Where does One rest with ?? 23 +1*
(Painting 9. Ink and color on paper ~ 70 x 50 cm, 2019)
Art concept: Self-image or Perceived-One image (please also see Figure 25)
Part of the Farewell my concubines subchapter

Figure 22. *Aspects of Perception: One is always Modular*
(Float bamboo craft 4 with bivalve laden rocks and sea urchin shell, ~70 x 70 cm in length)

Part of the Farewell my concubines series

The seen bamboo root is held with another float bamboo shoot, copper patinas balancing
Art Concept: as in the previous page. All laws are one, where is one?
The Chinese character One (一), heavy-weighted
One always assumes relativity, to the mean? median and average ? to the 'norm'?
To the extremes? to the sky? and to the star ?
amongst the moving averages, once a while, we receive a good run = a better share.
The balancing of expectations with perceived pay per unit effort
Self is also tentative, one with perceived image, one with wishful image, and one with self ?
The feeling of modularity is always a two-way process,
aspects of perception fonder with
Optimum Foraging Theory (Figure 3) (Hughes 1980)

Figure 23. *A Moving Average Blink:* ***$[2^2-1]+[2^2+1]=2^3-1$***

Original photograph compilation re-interpreting the Zen Buddhist compilation 'Where is one'

(7 x 5 =35) the moving average with retrospect.

Zen Buddhist compilation. https://terebess.hu/zen/zhaozhou.html

Zhao Zhou also known as Zen Master Joshu (222)

https://terebess.hu/zen/mesterek/rec.pdf

The monk asked zen master Zhao Zhou: '(趙州) (778—897)

"All ways are one, where is one?" (萬法歸一. 一歸何處) Zhao Zhou answer, "I made a green cloth shirt in Qingzhou, weighing seven catties.

'Cloth shirt (布衫) idealographic with 'put three'

[3] + [7]=10; The Chinese character of ten (十) signify an alternative symbol of Buddha.

[7] signify the path to Arhat

A normal distribution meaning some afront and some behind the cohort bloom

The germination of dinoflagellate resting cysts commands a stipulated dormancy amid environmental conditions, likely contributing to the synchrony of next season bloom

(Anderson & Keafer 1987, Genovesi et al 2009). See also Figures 18

The ' in AND *out' (Buddhism) per engagement* ***2^0 per 2^3-1***

One need to be in prior to be out-in, 'From the Way come One, from one come two, from two come ***three,*** *from which a multitude intermingles in well-balanced Yin and Yang'–*

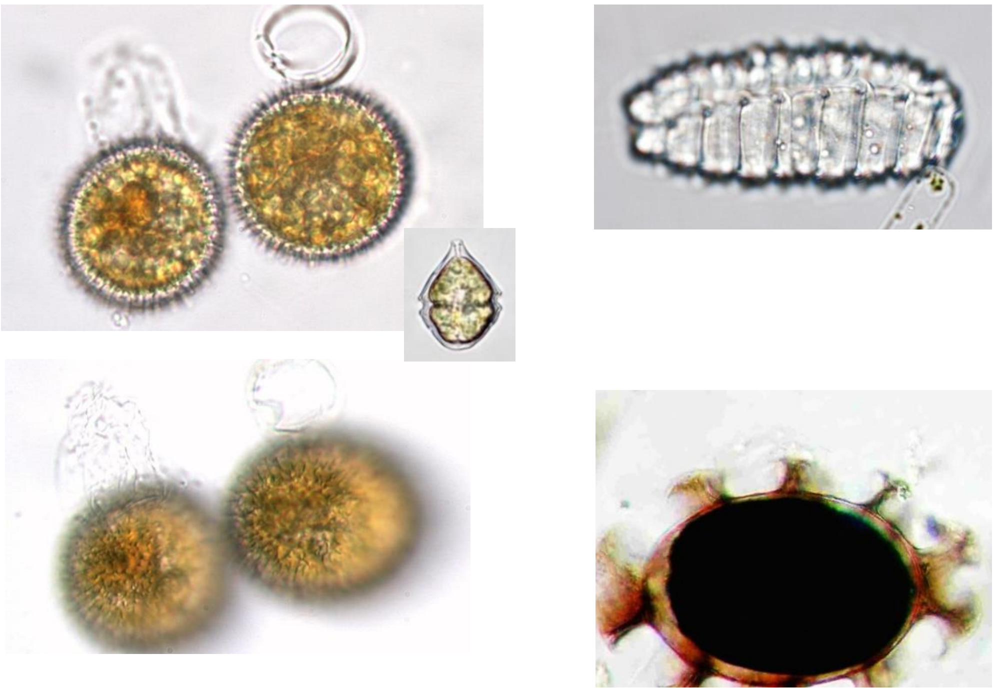
legendary Laozi (4th or 6th century B.C.) Dao De Jin Chapter 42

'The Sutra in Forty-Two Sections said by Buddha' https://www.buddhisttexts.org/products/the-sutra-in-forty-two-sections-%E4%BD%9B%E8%AA%AA%E5%9B%9B%E5%8D%81%E4%BA%8C%E7%AB%A0%E7%B6%93%E6%B7%BA%E9%87%8B

The 'All~Mighty' in Douglas Adam 'Hitch Hiker Guide to Galaxy' *said '42'* '[$2^2$2] (For-ty-2)

Qingzhou' phonographic with 'green province', and will need another subchapter to explain:

[2^2-1] + [2^2+1] *when one got self,* = 2^3-1 *the removal of one leading to the enlightenment path*



Left. *Two cysts of Scrippsiella acuminata (32-34 µm) showing the focused carbonate shell(Head et al 2006) on the bottom panel. insert: S. acuminata swarmer cell ~33 µm*

Right. *Top-bottom: A swarmer cell- cyst of Polykrikos schwartzii (~102 x 74 µm) showing the protrusions which in many species can be sticky.*

Photomicrographs taken by Mr. Stanley Ping Chuen Law

Figure 24. *Dinoflagellate cysts- Transforming within One: From 1.5 to 2.0 ? -1.0*
While a half-degree Celsius temperature increase might seem negligible,
it can be life or death for many species attributed to sustained secondary effects in combination.
Carbon capture is a global issue that cannot be easily traded or compartmentalized.
In this context, biomineralization may have a better energy footprint (Bougie et al 2019)
than chemical carbon capture methods. (see Figure 1B)

6. Dinoflagellate cysts

Dinoflagellate cysts have served as proxies for paleo-oceanographic conditions (de Vernal & Rochon 2023), including periods with much higher ultraviolet irradiation and temperatures. Cyst formation, notwithstanding the chemical resistant outer cyst wall, involves a complete change of cellular parameters for the sake of persistence. Historical cysts over 150 years old were 'revived' and induced to hatch (Delebecq et al 2020). It's worth noting that vegetative swarmer cells of dinoflagellates are haploids, while the zygote (planozygote) is diploid.

Some dinoflagellates, known as 'calcareous dinoflagellates,' deposit calcium carbonate on their cell coat. The molecular mechanisms of biomineralization, involving carbon sequestration, control supersaturation and spatiotemporal deposition at the right place(s) and time, with energy self-sufficiency. These organisms have had several hundred million years of evolutionary time to perfect this process (Keupp 1991).Metamorphosing from a swarmer cell into a cyst involves a complete change in metabolism, and cell coat composition, preparing the organism for long-term survival. All these transformations occur within a single cell, which is truly remarkable. A~mazing is an understatement.

See Figure 26 legend for further description. The implications of these processes extend beyond the microscopic world.

Figure 25. *One Tidal Cohort Color, as well (Painting 10. 35 x 90 cm, ink-color on paper)*

From left-hand top gradient to the right-hand bottom, the cells are depicted to go through a life cycle, eventually forming a non-flagellate coccoidal cyst that's ready to sink, with changes in cell wall components. In dinoflagellates, the coat chemical dinosporin, which exhibits chemical resistance as that of sporopollenin, is *deposited to reinforce the durability of the cyst wall. In biogeographical time of hundred million years, many of these cysts were fossilized with cohorts of the time, forming characteristic layering. These represent markers in paleo-sedimentological prospecting for fossil fuel (Bogus et al 2012), with their oil-rich cyst wall likely contributing to barophilic petrification to petroleum. These are advanced fabricable polymer technology, with urgent call for plastic replacements, that biodiversity will help us to prevail (as well).*

With COP28 pledge to replacing fossil fuel, dinoflagellate oleaginous cells (Figure 8) (Kwok et al 2023b), as well as their internal cellulosic thecal plates may serve as a source for green cellulose (Fig.12)(Kwok et al 2023b) and may provision fossil fuel replacement.

Whether climate change will increase harmful algal bloom frequency, the demise of symbiotic dinoflagellates with expulsion from their coral hosts may be related to their higher sensitivity to increasing ultraviolet irradiation, with the advent of ocean warming. Most photosynthetic dinoflagellates contain the additional carotenoid pigment peridinin, in addition to chlorophyll pigment (Polívka et al 2008), harnessing light energy in the euphotic zone which can be at a depth of over 200m.

(the double-sized biflagellate cell at right hand bottom (blue arrow) in the above painting) which can also conduct vegetative cycles without going to cyst formation, with decisions judged with prevailing environmental conditions.

This painting, in no way to depict the beauty and strong tidal range of Menai Strait, is dedicated to Prof. G. E. Fogg. It is on the Menai Bridge that we often met, on my way back from quick visits to the marine science library whereas my professor was on his way home after lecturing at lower Bangor. Our dialogues were never on weather; his encouragements to do plankton research have driven me through many challenges ahead. I did not know at the time he was a keen gardener and co-editor of the New Biology periodical (Penguin) which published rather inclusive science despite a popular series. Not a university with a lot of resources, but a small research boat and a strong believe in basic research.

With Waters Staying Me

Part afrontal part after

Catch uncertain-ty

Turling, turning, stroking with direction

Light shallow deep spectrum

Middle maxium chloro~phyll Per-dinin[1]

drilling in~frontal part behind

Nothing seen to move

Be~frontal of water laid

Surface dare the shorter wavelengths

Turbulence we dug

Skin dive to benthos

We flow into one, surface awash

Cleansing with routes

Cleaning no need, ecdysis and flagel~lA

Fine, fine sanding, musking tidal and littoral

Brightened taste of wind

Lightened the promise of land

Not with a pollen

Not with a whimper[a]

Where lesser aqueous[b]?

Bud with dino-spore

Grinning with sulcus

Searching for another time

Post-frontal

Am I a better one

Am one a better self

Am self a betterment

A~gain ?

Some interstitial sands

Some symbiosis with corals,

clamming giants

Some come with oysters[2],

some glide the seas

Sum blooms with under-current,

Sargas~sum[3]

Sum blooms with iron feasts[4]

From one to fifth log-a-rihymic

color to show the sky[5]

[a] Nevil Shute '*On the beach*' (Heinemann 1957)
'*That's the way the world ends, not with a bang but a whimper*'
In correspondence with bacteria of Deinococcus sp. that survived radiation (Zahradka et al 2006), dinoflagellate genomes have multiple copies of each gene, implying even with radiation damages, there are likely some functional copies that remain for reassembly. [b]*Lesser-aqueous condition likely involved in the lowering of metabolic rate per cyst formation.*

1. Dinoflagellates have the special carotenoid peridinin for photosynthesis; attributed to solubility, the Chla-peridinin complex is a major model for optical-physic studies of photosynthesis(Polívka et al 2008).
2. The oyster parasites *Perkinsis* sp. https://www.dfo-mpo.gc.ca/science/aah-saa/diseases-maladies/perkinasoy-eng.html
3. Iron fertilization experiments proposed to increase carbon sink to ocean bottom may not work out chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.greenpeace.to/publications/iron_fertilisation_critique.pdf
4. Sargassum Sea Belt is now extending across the Atlantic, and may have affected lesser central gyre water sinking, which in addition to climate change-mediated ocean patterns, may have contributed to the demise of the North Atlantic Meridional Overturning Circulation
https://www.space.com/ocean-current-system-shut-down-2025-climate-disaster
https://theconversation.com/the-great-atlantic-sargassum-belt-is-carrying-a-massive-bloom-of-brown-seaweed-toward-florida-and-the-caribbean-202570
The circadian rhythm of dinoflagellate bioluminescence at North Sargasso Sea(Batchelder et al 1992)
5. Dinoflagellate blooms, including those of *Noctiluca scintillans*, are observable with satellite(Detoni et al 2023, do Rosário Gomes et al 2014)

7.Epilogue.

This ScienceArt Commune has been compiled with different levels of inclusiveness, in preparation for both online and venue exhibitions. The chapter features approximately 25-30 sciencearts, hopefully with videos, music (at a later stage), and installation arts. Several subchapters focus on specific topics such as bioluminescence, cellulose synthesis, and chromosome stricture (not shown), each of which could stand-alone as exhibition subjects. Given the relevance of dinoflagellate biology to climate change, algal blooms, coral bleaching, and seafood poisoning syndromes, ScienceArt Communes can fit different matrixes for science communications. I hope other art-minded scientists can come forth to share their interests with a wider audience, including non-scientists, thereby supporting the sustainability of science in our knowledge-based society.

As we enter the post-genomic era with multiple genetic transformation systems, the hitherto genetically 'intractable' dinoflagellates will become strategic for basic and applied research in many areas. Beyond their prominence in harmful algal blooms and coral bleaching studies, dinoflagellates are significant for their intracellular cellulosic thecal plates, carbonate biomineralization, and some of the highest oil content, notwithstanding the highest DMS/DMSP production. The caveat is that their nuclear envelope does not breakdown during cell division. This feature, combined with amendable cell cycle synchronization methods, implies that any positive-negative regulatory pathways (e.g. between nuclear-cytoplasm) will not be 'self-`neutralized' upon lysing (as occurs in many other cells), facilitating to investigations into the one-self and all concubines.

8. Acknowledgements.

We apologize to colleagures whose works we have not included in this art compilation.

The narratives were exhaustively improved by Alvin Chun Man Kwok (HKUST) who also provided all scientific diagrammatic illustrations and seek copyright issues for me. Various members of Wong's laboratory contributed photomicrographs, including Man Ho Chow, Alvin C.M. Kwok, Mike Bennett, and Shao Ping Wen. Stanley Ping Chuen Law, a long-time associate of the laboratory, provided images of cysts. Most of my artworks were accumulated during my recovery from the almost lethal liver failure attributed to hepatitis A. During that period, I could only frustratedly write or lecture for 1-2 hours a day due to fatigue. Interestingly, engaging in art seemed to combat fatigue and help reconnect damaged neuronal networks, perhaps creativity is indeed a state of mind. An earlier version of this compilation was reviewed by Nick Money from Miami University, USA, and John Bostock from the University of Stirling, UK. Chinese versions of this ScienceArt Commune will feature all artworks with translations and additional Chinese verses.

All the ScienceArts Driftwoodwork crafts are dedicated to the late Tilda and Donald S. Gill (Earley, Berkshire, U.K.), my high school guardians. DSG, a member of FoMRHI (https://www.fomrhi.org), taught me woodwork techniques with which I do not make justice to the immaculate finish he demanded. Tilda, alma mater of Bangor University, introduced me to humanity and reading novels. Amongst the early teachers who introduced me to planktons are Stanley P.C. Law, Patsy P.S. Wong, the late G.E.Fogg, and John Dodge. My laboratory did not have resources to conduct bioluminescent research that the late Woody Hastings repeatedly urged me to spend time. I thanks my my creative science teacher who spent so much time in educating me. I sincerely regret I did not accomplish the first chapter prior to COVID, during which I see passages of my parents.

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