Rediscover JUNKAN

Monthly JP pavilion

Feature

Ending is the Beginning

Issue

02

The Future of Our Earth May Be in the Hands of the Microscopic World.

Feature

Exploring More Than 1 Kilograms of Microorganisms in the Human Intestine: A Symbiotic Relationship

Mr. Umezaki continues his research on microorganisms. The reality of the situation is “full of unknowns,” he says.

P.04

Revolve Around Microorganisms: Life, Earth, and Us

How is this world composed and how should we humans behave? The question spreads everywhere starting from microorganisms.

P.12

All Living Things Eat and Discharge: The Story of the “Cycle of Life” as Seen in the Food and Excretion of the Natural World

This is a story about the cycle of life that begins with “excrement,” which all humans do. There were hints that would lead us to the future.

P.22

Exploring More Than 1 Kilograms of Microorganisms in the Human Intestine: A Symbiotic Relationship

Index

Have you ever considered that we coexist with microorganisms and bacteria?It might sound astonishing, yet it's the reality of our symbiotic relationship with these tiny beings. Microorganisms are ubiquitous—floating in the air, drifting in water, residing in soil, and even covering our body surfaces. Among these diverse habitats, the human intestine stands out as a bustling hub of microbial life.
What roles do these invisible intestinal bacteria play? To unravel this mystery, we sought insights from Professor Masahiro Umezaki of the Graduate School of Medicine, the University of Tokyo.
Professor Umezaki's fascination with intestinal microorganisms began during encounters with the inhabitants of Papua New Guinea's highlands. Since then, he has delved into the study of these microbes through the lens of human ecology. However, he humbly admits, "There is still so much we do not know."
These unseen, enigmatic microorganisms hold a multitude of secrets. Yet, one certainty remains: contemplating our symbiosis with them offers a crucial perspective on embracing diversity.

Papua New Guineans Boast Muscular Physiques Despite Sweet Potatoes Being Their Staple Food

—— Why did you decide to focus your research on intestinal bacteria?

Umezaki My specialty is human ecology, the study of what defines us as humans and how we live. During my early anthropological research days in Papua New Guinea, I was struck by the differences in body structures of the local people, despite their shared ancestry. Their primary sustenance is sweet potatoes,

with a significantly lower protein intake compared to the Japanese diet. If we consumed the same fare, we'd likely be thin, yet they exhibit robust, body-builder-like physiques. It's quite perplexing, isn't it?
While the genetic makeup of different populations certainly plays a role, it seemed unlikely to me that genetics alone could account for such a stark contrast. That's when I began considering the role of intestinal bacteria.

—— Are you suggesting that the microorganisms in the bodies of people living in Japan and those in Papua New Guinea function differently?

Umezaki It's not so much about the function, but rather the composition of microorganisms within each person's body that differs greatly. For example, New Guineans produce little to no lactobacilli, while harboring bacteria that are less abundant in Japanese individuals.
However, the full extent of this diversity remains elusive. Many bacteria have been identified by name, yet their specific functions remain a mystery. There are even more unnamed species. The collective weight of intestinal bacteria in an adult male's body is roughly 1 to 1.5 kilograms, equivalent to that of the brain. It's quite substantial.
In our research, we've been transporting fecal samples from Papua New Guineans back to Japan and partnering with a professor from the Faculty of Agriculture to analyze the microorganisms they host. When we introduced these microorganisms from their feces to laboratory rats, even in a protein-deficient state, the rats didn't lose much weight.
This outcome suggests that the function of intestinal bacteria plays a significant role in the robust physique observed in Papua New Guinea highlanders. Often, high school textbooks describe the large intestine's function as "absorbing water." However, its role extends far beyond that. It serves as a habitat

A tank used to bring back collected fecal matter from overseas. It is constructed to keep the inside cool. With the tag, "MUST RIDE".

for bacteria with diverse functions, such as breaking down dietary fiber and synthesizing vitamins. Through further investigation, we may even discover microorganisms with immunity to certain diseases.

Humans Can Even Live Like Gorillas?

—— What is it that causes such a difference in intestinal bacteria between people living in Japan and those in the highlands of Papua New Guinea?

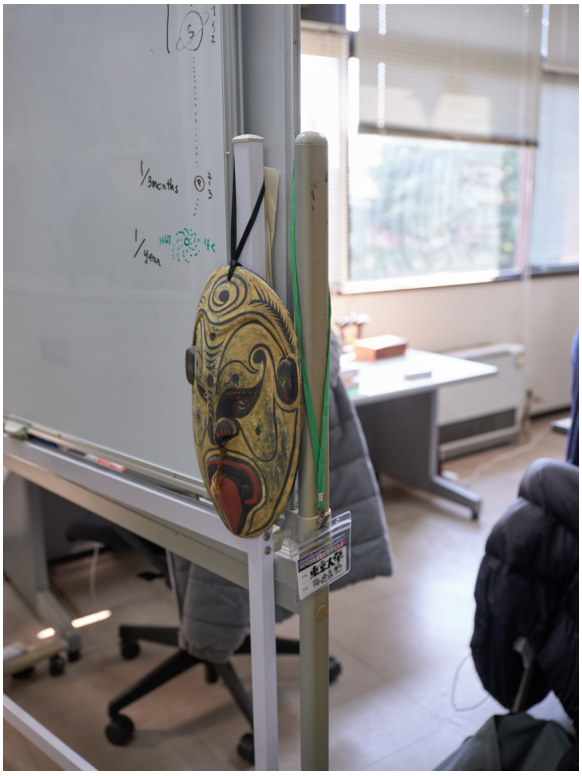
Umezaki To be honest, it's still unclear. As a researcher, this uncertainty can sometimes feel quite "romantic"! (laughs)

—— So, you believe that ongoing research could lead to significant discoveries?

Umezaki To give you a sense of the possibilities of my research, let me share a broader perspective.
Consider gorillas, herbivores, and fellow primates to humans. Their staple diet consists of wild plants, lacking in protein. Despite that, gorillas boast large, powerful bodies. Why then, can't humans consume wild plants like gorillas, despite being of the same primate species? I suspect that humans once had this ability.
Wild plants contain phytochemicals, toxic substances meant to deter predators. However, herbivores possess intestinal bacteria capable of detoxifying these substances. Humans, with a few exceptions, cannot consume wild plants raw like herbivores.
The history of Homo sapiens spans approximately 200,000 years, roughly

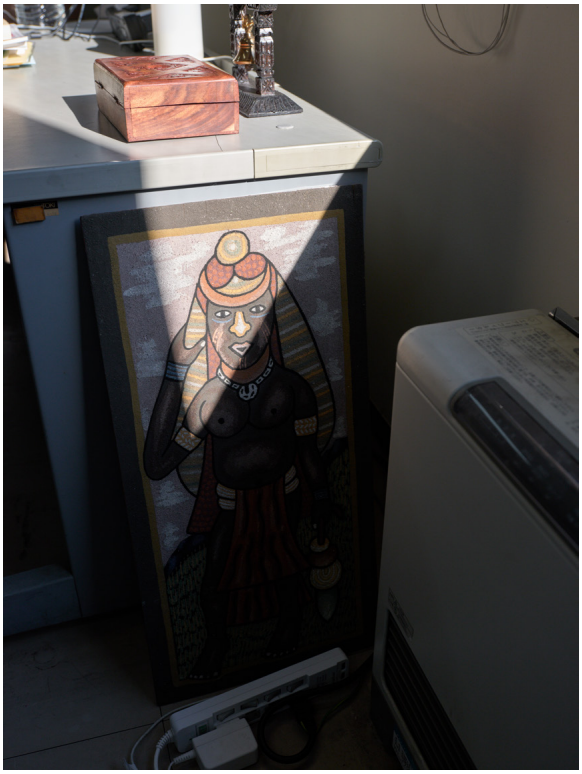
10,000 generations if we consider 20 years as one generation. If we trace back 10,000 of your own mother's mothers, it leads to the birth of Homo sapiens. Agriculture, however, only began about 10,000 years ago. This suggests that for 190,000 years before agriculture, people lived in the wild.

With the advent of agriculture, we gained access to rice and vegetables, and following the Industrial Revolution, meat and eggs became more readily available, but these were not part of our original diet. Considering this history, the period when we survived on wild plants and animals was longer. Our modern diet is more peculiar, and in understanding our survival through those times, we cannot overlook the role of intestinal bacteria.



— Does this mean humans originally possessed the ability to thrive in the natural world?

Umezaki With a balanced diet now the norm in this world of abundance, it's possible that humans have lost this ability, or perhaps we are simply unaware of it. While I don't aim to equate humans with gorillas, people in Laos subsist on wild plants, and even in Papua New Guinea, plant-based diets prevail.
If one were to adopt a lifestyle in Papua New Guinea tailored to the local diet, they would likely lack sufficient protein. For instance, if I were to live this way, I would struggle to heal wounds and could eventually fall ill or even succumb to malnutrition. However, with prolonged adherence to the local lifestyle, the body might adapt, mimicking the gut bacteria of the locals. Depending on what is considered "natural," one might possess an ability to live closer to the wild.



There Are No “Bad Microbes”

— But aren’t there many microorganisms and bacteria that are harmful to humans?

Umezaki That’s an anthropocentric notion. I understand it’s challenging to be aware of bacteria since we can’t see them. However, if we view them in terms of the relationship between humans and other organisms, it leads to the idea that it’s acceptable to eliminate other organisms for human survival. Even though some pests are ecologically necessary, categorizing them all as “bad” is perilous. It would result in a loss of diversity.

If we eliminate harmful organisms, we inadvertently eliminate beneficial ones, leading to the collapse of the ecosystem. Bacteria operate similarly. While many would consider them “bad,” they actually provide us with protection. Yet, we unknowingly eradicate various bacteria. In Japan, livestock are kept in complete isolation for hygiene purposes. While this is correct for hygiene, it also means that the exchange of bacteria between pigs and humans, which naturally occurred when they lived together, has been lost. I believe many bacteria have become extinct because they’ve been deprived of their natural habitat. We might feel saddened by the reduction of cute animals, but we don’t quite have the same emotional response to the death of invisible bacteria.

This isn’t to say we shouldn’t wash our hands or use antibiotics. However, prioritizing only human concerns can distort an ecosystem.

Regarding bacteria, those responsible for cholera, dysentery, and typhoid

fever were once labeled as “bad.” Yet, the discovery of symbiotic relationships between humans and these bacteria is shifting perspectives. There’s room to question whether living in an excessively “clean environment” is truly beneficial. Perhaps it’s time to consider the diversity of microorganisms alongside the diversity of visible life forms.

To Have a Diverse Diet Is to Live with Diverse Microorganisms

— What kind of symbiotic relationship should we have with microorganisms?

Umezaki Herbivores don’t store nutrients to “become food for carnivores,” do they? The microorganisms in our large intestine thrive by consuming the leftovers that pass through the stomach into our intestines. We aren’t consciously trying to “nourish” these intestinal microorganisms.

Throughout our extensive history, humans have consumed a variety of foods across different regions. I hypothesize that bacteria in a mutually beneficial relationship have endured. Essentially, the diversity of intestinal bacteria can be partially maintained by the diversity of human diets.

Though we are said to have a diverse global diet, most of us reside in urban areas. Chinese, Japanese, and American cuisines—while distinct—are not vastly different in terms of carbohydrates, proteins, fats, and nutrients.

People truly consume a wide range of foods. While I’ve only directly experienced the diet in Papua New Guinea, some African pastoralists subsist solely on dairy products like milk and yogurt. In contrast, the Dirashe people of Ethiopia have diets rich in alcohol. Despite their seemingly imbalanced diets from our

modern perspective, they thrive.
The guideline of “how many grams of protein should be consumed per day” is established without considering the role of intestinal bacteria. Certainly, increased protein intake has contributed to a much longer human lifespan, which once averaged around 30 years. However, there are individuals whose diets fall outside these standards.
What kinds of intestinal bacteria do they possess, and how do these bacteria function? As we gather case studies, we may uncover how intestinal bacteria have influenced the survival of the human race.
Today, Japan’s diet has become standardized, but historically, people likely relied on locally sourced foods, each region with its distinct cuisine. Many are surprised to learn that Papua New Guineans primarily consume sweet potatoes as their staple food, yet our diets were once similar.
We often perceive the world through the lens of the majority, but we require this broader view encompassing time and space. While my current research focuses on modern Papua New Guinea, I aim to contemplate the future of human society from various perspectives—examining past human diets, the associated microorganisms, and the environments in which they thrived.

Revolve Around Microorganisms: Life, Earth, and Us

Index

When the term microorganisms comes to mind, what image does it conjure? Perhaps benefactors that decompose waste, or enigmatic entities ubiquitously intertwining with our existence? Our understanding of these microscopic beings is often shallow, despite living around and within us by the trillions, essential to our survival. The definition of a microorganism is deceptively simple: an organism too small to be seen by the naked eye. Yet, this simplicity belies the complexity and crucial roles these tiny organisms play in life's grand tapestry and their intricate connection with us. In this edition, we aim to demystify microorganisms, exploring their pivotal contributions to life's cycles and their symbiotic relationship with humanity.

Our journey led us to Mr. Shin-ichi Fukuoka, a distinguished biologist and the thematic project producer "Dynamic Equilibrium of Life," a pavilion dedicated to unraveling the mysteries of life at Expo 2025 Osaka, Kansai. Fukuoka, celebrated for his insightful book "Seibutsu to Museibutsu no Aida (Between Living and Non-living Things)," sheds light on microorganisms, linking them to broader environmental dilemmas and the essence of life itself. His reflections provoke a deeper contemplation on the composition of our world and the role we, as humans, ought to play within it. By the end of this article, your perspective on microorganisms will change forever, leaving you to ponder their significance long after the lights go out.

Words: Shin-ichi Fukuoka

Breaking down and Rebuilding: Revisiting the Definition of Life

Before delving into the realm of microorganisms, it's imperative to address a fundamental question: What is life?

Merely listing observable characteristics like cells, DNA, movement, metabolism, and respiration falls short of capturing life's true essence. My initial foray into biology in the early 1980s, a period marked by the advent of biotechnology, was driven by a fascination with molecular biology—the study of life's microscopic mechanisms within cells.

I too was immersed in the trend of isolating individual microscopic molecules like DNA and proteins to analyze their mechanisms, essentially viewing life through a mechanical lens. The prevailing belief was that unlocking the secrets of life was as straightforward as deciphering the DNA blueprint, which comprises 20,000 different proteins, through initiatives like the Human Genome Project.

However, a profound realization emerged from our DNA studies: understanding all 20,000 proteins would not bring us any closer to comprehending life. This revelation prompted a shift in focus from separating life into individual components to exploring the interactions between these components. We began to see life not as a static entity but as a dynamic phenomenon. It became clear that life is not about the simple exchange of old for new through metabolism; rather, life is about actively dismantling itself and using the ensuing instability to re-establish order.

This concept, which I've termed "dynamic equilibrium," is the cornerstone of my theory on life.

Fukuoka's Original Exploration of Life: The Shared Nature Among All Living Things

As a child, I was what you might call an insect aficionado. With few human companions and a naturally introverted demeanor, I found solace not in the gaze of people but in the intricate details of the ground beneath me, exclaiming in silent wonder at the sight of a longhorn beetle. My days were filled with poring over insect encyclopedias and venturing outdoors in pursuit of these creatures. For a summer project, I meticulously documented the breeding patterns of butterflies, fascinated by each species' unique preference for certain leaves. Swallowtail butterflies favored the leaves of mandarin and trifoliate oranges, while yellow swallowtails were drawn to parsley and carrot leaves. The Chinese windmill butterfly sought out the slender Dutchman's pipe. Despite the uniform nutritional value across these plants, I was intrigued by their selective diets.

As an adult, this observation blossomed into a deeper understanding: butterflies diversify their diet to minimize competition for food, a strategy essential in a world where resources are finite. This behavior exemplifies dynamic equilibrium, not just at a cellular level but within entire ecosystems.

Another profound lesson emerged from my study of butterflies—metamorphosis. A larva emerges from an egg and, over time, sheds its skin to form a chrysalis, entering a state of motionless transformation. As a young insect enthusiast, I once peered inside a chrysalis, expecting to find a larva in transformation. Instead, I discovered no larva at all, but rather a black liquid that had once been the larva, now reduced to sludge. The larva had been utterly dismantled in the process. Yet, from this apparent destruction, life renews itself, using the nutrients from the sludge to give rise to a butterfly. This process, if observed by someone unfamiliar with Earth's biology, would seem miraculous—how could the larva and butterfly be the same organism?

This cycle of destruction followed by creation was my first personal encounter with the

principle of dynamic equilibrium. It also marked the beginning of my lifelong awe and respect for the intricate and resilient processes of nature.

Respect for Microorganisms: A Key to Earth's Survival

As we delve into the realm of the unseen, it becomes clear that our world teems with countless invisible life forms: microorganisms. Antoni van Leeuwenhoek, a 17th-century Dutch scientist from the small town of Delft, was a pioneer who first glimpsed these mysterious organisms through a homemade microscope capable of 300x magnification, revealing the bustling life in what appeared to be transparent river water.

So, what roles do microorganisms play? Essentially, microorganisms are pivotal in driving the cycles of life.
This brings us to the concept of dynamic equilibrium, where life is a continuous flow of

decomposition and synthesis. Who orchestrates the major cycles on Earth? It's the carbon atom, currently vilified amidst global warming concerns. The aim for a decarbonized society is widely discussed, yet it's crucial to remember that humans are carbon-based beings. The real issue is not carbon itself but the disruption of the global cycle. Microorganisms transform carbon into organic matter, which is subsequently broken down into simpler forms. Thus, we ought to appreciate the efforts of microorganisms, particularly those of plant origin, for their significant role in the carbon cycle.

Moreover, microorganisms are instrumental in energy circulation. They harness sunlight, converting it into organic matter, and generously share it with other organisms. For instance, plants engage in photosynthesis beyond their own needs, offering their leaves, fruits, and roots to other life forms.

Admittedly, not all microorganisms are benign. Pathogens like cholera and dysentery bacteria pose significant threats. However, the vast majority of microorganisms are not only harmless but also beneficial to humans. The topic of intestinal bacteria has gained prominence recently. It's easy to assume they merely consume our food, but in reality, they detoxify harmful substances, transform nutrients into more accessible forms for us, and even serve as a protective barrier against external threats.

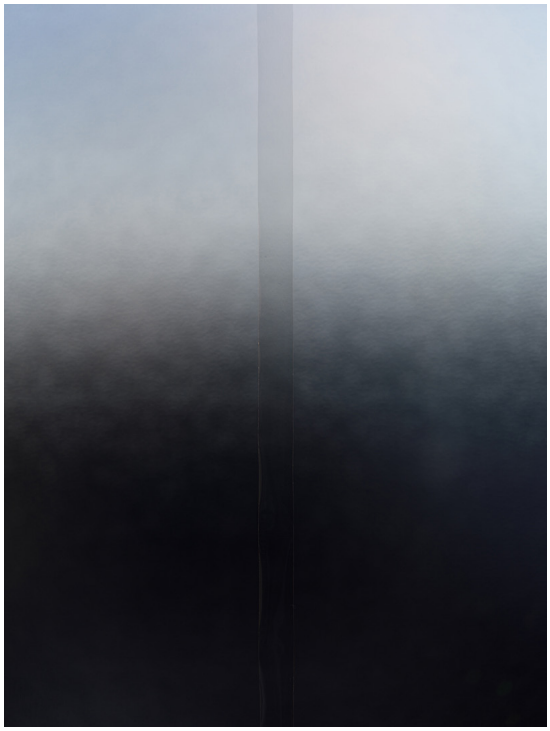
The trillions of microorganisms in our digestive system play a crucial support role. The composition of these microbial communities varies with the climate of one's environment. For instance, Japanese individuals, who consume a considerable amount of seaweed, host numerous bacteria capable of breaking down seaweed. Recent findings also indicate that the metabolic activities of intestinal bacteria impact not just physical health but our psychological state as well, highlighting a direct link to mental health concerns.

Recoverable Cycles of Our Planet: Call to Action in the Grand Scheme of History

In the vast tapestry of Earth's history, cycles of change have always been recoverable. Life on Earth, with its 3.8 billion-year history, has seen dramatic environmental shifts. Oxygen once ranged from 20% to 30% in the atmosphere. Ice ages enveloped the planet in frozen expanses. Dust from asteroid impacts shrouded the world, blocking sunlight. In this darkened era, photosynthesis ceased, leading to the demise of plants, herbivores, and eventually, the mighty dinosaurs. Yet, from this brink, a new age dawned as resilient creatures like rats ushered in the era of mammals. Earth's dynamic equilibrium persisted, adapting through turmoil.

Today's environmental crises, however, are not natural phenomena. They are the consequences of human actions, where we have assumed dominion over the Earth's resources. Acting selfishly instead of nurturing the cycle, we have disrupted the balance.

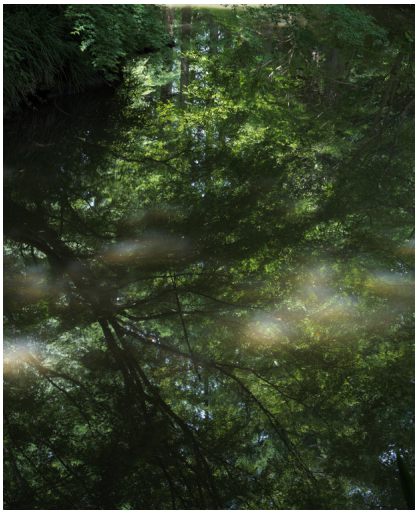
Human societies often prioritize selfish order within their communities, unwittingly unleashing entropy—disorder—manifested in mounting garbage and carbon dioxide emissions. While Earth can absorb some level of entropy, we have surpassed its limits. What we face today is less an energy crisis and more an entropy crisis.



Living in the Future: Rethinking the Standard

To truly live in harmony with our planet's ecosystems including microorganisms, we must reconsider our consumption behaviors regarding food, clothing, and shelter through the lens of entropy. Humans have disrupted the natural cycle by accumulating wealth unnecessarily. This accumulation not only puts strain on the environment but also goes against the natural order observed in other organisms. While other beings secure what they need and pass on the surplus, humans uniquely hoard wealth. This accumulation of wealth is not just about numbers; it directly impacts the global environment. Humans have exploited natural resources like oil and coal, claiming land that belongs to no one. To coexist sustainably, we must transcend individual desires and champion altruism as a political and social movement.

The Japan Pavilion at Expo 2025 Osaka, Kansai, holds immense potential to spread these crucial messages. In Japan, the concept of "yaoyorozu no kami" emphasizes that divinity resides in all places and things. This sentiment aligns with the opening lines of Hojoki (A Hermit's Hut as Metaphor), stating, "The flow of the river never ceases, and the water never stays the same. Bubbles float on the surface of pools, bursting, reforming, never lingering." This simple expression embodies the concept of dynamic equilibrium. We must reevaluate life through the lens of nature's constant flow, avoiding dichotomies and seeking moderate solutions within this ebb and flow. This is a unique attribute of humanity.



Humans, with their intelligence, have constructed civilizations, cities, institutions, and economies. In this journey, we've recognized the value of individual life, including basic human rights. Nature, on the other hand, operates on the premise of species survival above all. While our intelligence has led to the structuring of the world, we must acknowledge when it has overreached. We find ourselves at a pivotal moment where we must seek harmony with all life forms, including microorganisms.

Photo: Go Itami

Biologist and Writer

Shin-ichi Fukuoka

Born in Tokyo in 1959, Fukuoka earned his B.A. and Ph.D. from Kyoto University. After completing a traineeship at Harvard University and serving as an assistant professor at Kyoto University, he is currently a professor at Aoyama Gakuin University and visiting professor at Rockefeller University. Shin-ichi has authored a plethora of works, such as “Seibutsu to Museibutsu no Aida” and “Doteki Heiko” series, both of which scrutinize the essence of life through the lens of dynamic equilibrium theory. Fukuoka is also a devoted admirer of Vermeer, who coincidentally lived during the same era as van Leeuwenhoek, the pioneer in discovering microorganisms. It is said that Vermeer’s painting techniques may have been influenced by van Leeuwenhoek’s microscope. Additionally, Fukuoka serves as the thematic project producer for the Signature Pavilion, “Dynamic Equilibrium of Life.”

HP: https://www.fukuokashinichi.com/

All Living Things Eat and Discharge: The Story of the "Cycle of Life" as Seen in the Food and Excretion of the Natural World

Index

The cycle of nature revolves around the “cycle of food and excretion” of all living things. Every organism eats and excretes to survive. This interconnectedness sustains the natural environment. While much attention is given to “eating” in various contexts, “excretion” is rarely discussed. In this exploration of the cycle of life, a topic both familiar and often overlooked, we uncover insights that can guide us toward the future.

Reasons Why Forests Aren’t Overflowing with Fallen Leaves, Carcasses, and Excrement

Imagine entering a forest teeming with diverse life. It is filled with dense trees and fresh air that invites you to take a deep breath. You can sense the rustling of creatures, a stark contrast to the human world we typically inhabit.
As you walk along the path, the ground is covered with fallen leaves and exposed tree roots. The earth feels soft under your feet, unlike the hard, unyielding asphalt. Walking barefoot, you would directly experience its gentle softness.
Naturally, no one is cleaning up the forest. So, why aren’t there piles of animal remains or excrement? Why aren’t the trails overflowing with fallen leaves?
Every day, animals excrete and die, and leaves fall. In the human world, waste and remains are managed by people. In the natural world, this task is handled by microorganisms. Yet, this perspective is centered on human experience. The cycle of nature revolves around the “cycle of food and excretion” of all living things.

The Earth's Ecosystem: The Connection between "What We Eat" and "What We Excrete"

Living organisms categorize into animals, plants, and fungi.
Among them, animals exhibit diverse forms like lions, dogs, birds, and humans, all engaging in the fundamental activities of "eating" and "excreting."
Even in the depths of the sea, creatures like tubeworms, which cyclically process hydrogen sulfide through internal bacteria, adhere to this pattern. Despite the intricacy of their behavior, the specifics of their ecological role remain largely unknown. Broadly, animals sustain themselves through this perpetual cycle.

But what about plants and fungi? While plants lack a conventional excretory process, reconsidering "consumption" and "excretion" reveals their involvement in this universal cycle. Plants harness sunlight, atmospheric carbon dioxide, and water from roots to synthesize sugars via photosynthesis, concurrently releasing oxygen as a byproduct. Thus, the sustenance they derive constitutes their intake, while the surplus oxygen they emit acts as their excretion.
Fungi, on the other hand, subsist by decomposing organic matter like dead trees, fallen leaves, and animal remains. This decomposition liberates carbon dioxide into the atmosphere and inorganic nutrients into the soil. Plants then absorb these fungal excretions as food, taking in inorganic nutrients through their roots and carbon dioxide through their leaves for photosynthesis, which serves as their "diet." In turn, animals rely on plants for oxygen, generated through photosynthesis.
Thus, the interconnectedness of all life forms revolves around the intricate dynamics of "consumption" and "excretion."

In modern society, humans seem disconnected from this natural rhythm, often relegating discussions on human waste to the periphery of public discourse.
Our reliance on flush toilets epitomizes this disconnection, as waste is whisked away to treatment facilities. Here, through the activated sludge process*, microorganisms facilitate the breakdown of waste into solid sludge and water, with the latter undergoing filtration, deodorization, and disinfection before discharge into water bodies. Meanwhile, the solid residue is subjected to drying, incineration, or conversion into cement material.
While this engineered system has undoubtedly bolstered hygiene and curbed urban epidemics, it veers away from the innate cycle of "consumption" and "excretion" in nature. While repurposing waste as fertilizer underscores its utility, such practices primarily serve human interests rather than acknowledging nature's intrinsic life cycle.
Nonetheless, some individuals like Masana Izawa, self-identified as a "fecal ecologist," choose to live in harmony with this natural rhythm, recognizing the vitality of the ecosystem's cyclic dynamics.

*Activated sludge process: Organic matter is treated through alternating aerobic and anaerobic decomposition using microorganisms.

Mr. Izawa has been exploring and practicing the natural cycle of life through the lens of "excretion." A nature conservationist since 1970, he has been fascinated by the decomposition activities of fungi, documenting this world as a photographer. However, in 1973, upon hearing news of a campaign against human waste treatment plants, he began to contemplate "excretion."
While climbing mountains as part of a nature conservation campaign, Mr. Izawa became captivated by the mushrooms he encountered. He bought an illustrated book and learned that mushrooms, as fungi, decompose dead trees, fallen leaves, animal carcasses, and excrement, returning these materials to the soil. These nutrients fertilize the soil, promoting plant growth, which animals then consume, completing the cycle of life.

Izawa Thanks to fungi, the carcasses and excrement of animals and plants are broken down and returned to the soil, giving rise to new life. When I heard about the campaign against human waste treatment plants, I saw a connection with the work of fungi. That made me think, 'What can I do to help?

Drawing from his experience, knowledge, and living environment, Mr. Izawa decided to immerse himself in the natural environment, becoming an active participant in the cycle, just as animals, plants, and fungi do. He has been defecating in the forest on his private property daily for about 15 years, only using a conventional toilet a few times.
By visiting the forest, digging up the excrement buried in the soil, and examining the decomposition process of his own waste, Mr. Izawa has gained profound insights into the cycles of nature.

Izawa I always thought fungi were the main decomposers of feces, but when I started investigating and observing the process, I realized many other organisms are involved, and the process varies greatly. It's not just mushrooms and fungi; insects and animals also play a crucial role. Every time I go into the forest, I'm reminded of nature's incredible diversity.

As he spoke, he described the actual decomposition process in detail.

The decomposition process is complete, revealing earthworm excrement—a soil aggregate rich in nutrients essential for plant growth. This final form of excrement has been thoroughly broken down in the soil, providing an ideal environment for plant roots to absorb nutrients. It exemplifies how the excrement cycle enhances soil fertility.

Izawa When feces decomposes in the ground, it goes through two stages. The first stage is anaerobic decomposition, which occurs without oxygen and is carried out by intestinal bacteria. The second stage is aerobic decomposition, where fungi like molds and mushrooms break it down using oxygen.

The presence of mycelium signifies aerobic decomposition, transforming waste into soil-like matter.

Mr. Izawa himself has delved into the decomposition process of feces from various living creatures as part of his ongoing research. Through this lifelong endeavor, he claims to have gained numerous insights.

Izawa When I began my digging research in 2007, it took a whole month for the feces to decompose. However, last year, it only took half that time. Over the span of 15 years of burying feces, the microorganisms enriched themselves with abundant nutrients, leading to improved soil health and strength. During a recent digging research expedition last fall with explorer Yoshiharu Sekino, we stumbled upon an area where decomposition seemed unusually slow, despite almost two months passing since the excretion. Upon closer examination, we realized that the day before I deposited this particular excrement, I had been suffering from a cold and had been on antibiotics.

Mr. Izawa suspects that the antibiotics may have hindered the fungi's decomposition process. However, upon subsequent inspection after some time had passed, he found that even this excrement had eventually decomposed. Remarkably, even dioxin, a toxin known for its resistance to decomposition, is broken down by fungi like shiitake and maitake. Such is the potent decomposition power of fungi. On another occasion, a rare fungus was discovered in the mountains on Mr. Izawa's private property.

Izawa When the fungus researcher Yosuke Degawa visited, he stumbled upon the Linderina fungus in the soil he had been scouring. He had been studying an unidentified fungus species found in the intestines of cave crickets known as Rhaphidophoridae, hoping to uncover insights into fungal evolution. Linderina exhibited properties strikingly similar to those of the unidentified fungus. Consequently, he had been tirelessly searching for Linderina, which had previously only been sighted four times worldwide. If he couldn't find it, he was prepared to pay a hefty sum to obtain one from a specialty company. Much to my surprise, it was found in my forest. Subsequent research by Mr. Degawa revealed that this forest boasted three times the soil biota richness of the neighboring primary forest.

The Key to Connecting "End" and "Beginning" Lies in Excretion

Mr. Izawa remains dedicated to a method of connecting with nature and circulation. Excretion, in essence, serves as the link between the end and the beginning, between life and life. In simpler terms, it is intricately tied to the concept of death.

Izawa A corpse and feces share a similarity. Both are typically viewed with aversion, yet they are essentially comprised of the same deceased organic matter. But what if we perceive them differently? They both play a crucial role in passing life onto the next creature. Their demise does not mark the end of the story.

Just as eating and excreting are interlinked, something discarded by one being, having fulfilled its purpose, may be essential to another. Only by bridging the "end" and the "beginning" can the cycle of life be sustained.
Contemplating death at the culmination of life opens the door to a new beginning. This concept lies at the heart of cyclic existence, serving as the key to the intertwined activities of all living organisms.

Fecal Ecologist

Masana Izawa

Born in 1950, Masana's disillusionment with humanity led him to drop out of high school and embrace a reclusive lifestyle. In 1970, he embarked on a mission to preserve nature. Eventually transitioning to photography, specializing in fungi and cryptogamic plants since 1975. In 2006, he identified himself as a fecal ecologist, advocating for a harmonious coexistence between humans and nature through lectures and writings.
