Skipping Stones

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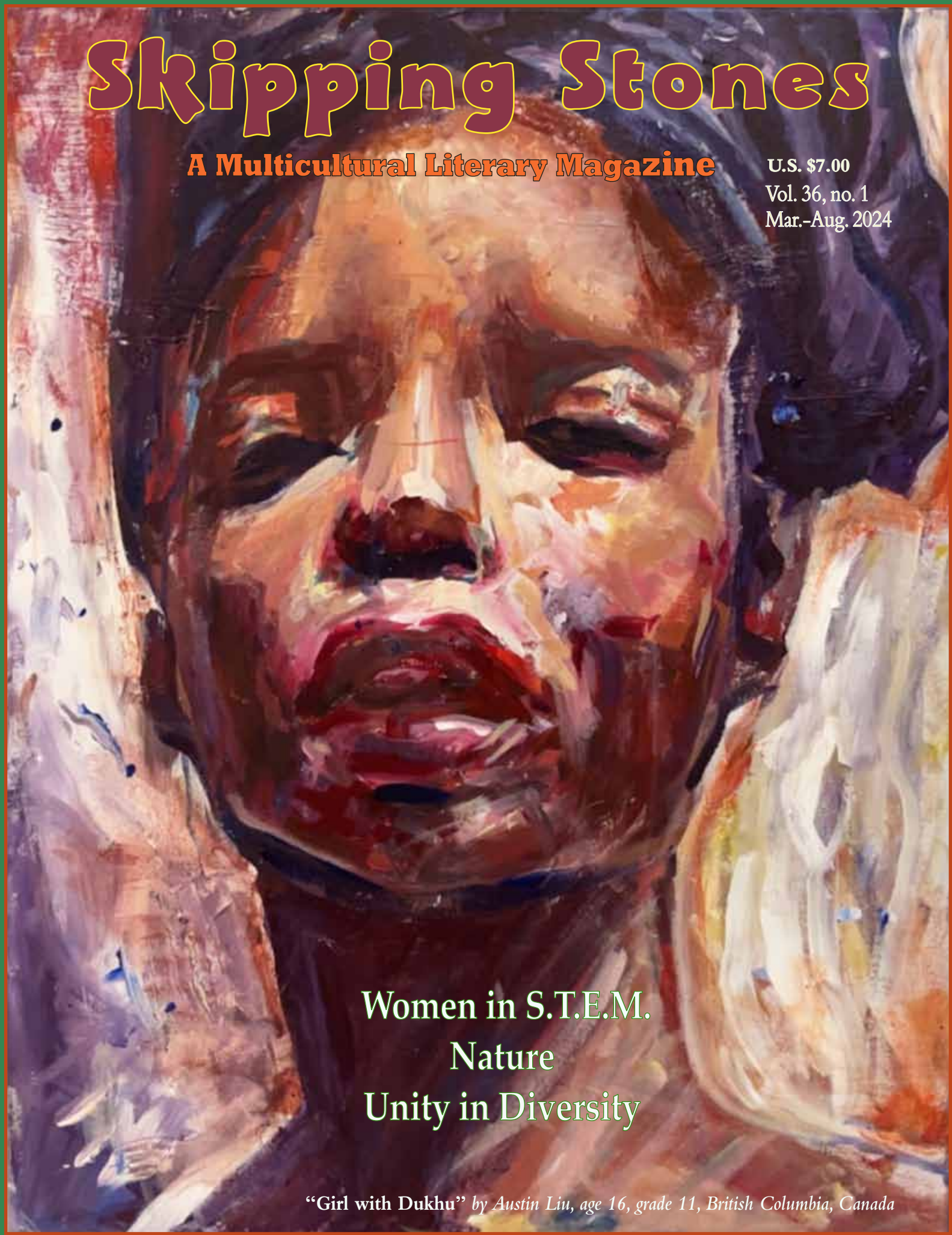

Women in S.T.E.M.
Nature
Unity in Diversity

"Girl with Dukhu" *by Austin Liu, age 16, grade 11, British Columbia, Canada*

First Place Winner: The Seamstress and the Mystery of the Argonaut

This is the story of Jeanne Villepreux-Power. Similar to Cinderella, it is the story of a poor girl who rose above her birth—a girl who did not lose a glass slipper and marry a prince, although she did make a dress for a princess. Moreover, it is the true story of a seamstress, a naturalist, and an inventor—a woman who defied the norms at a time when women were excluded from the sciences and shaped her own path for exploration.

★★★

Across the millennia, since before the Bronze Age, the Argonaut* had traversed the marine expanses of the globe. Her distinctive appearance of large eyes, two webbed sail-like arms, and intricate spiral shell, combined with her Lilliputian size, made her an object of great wonder and curiosity.

She swam leisurely across the seven seas, preferring the surface waters to the rocky depths of her tentacled cousins. Perhaps it was because of this fact that many wondered at her elusive and secretive existence, including the likes of Aristotle himself—even as the shy creature never lingered long in one place.

Now, at the dawn of the 19th century, a girl named Jeanne was born in a small rural village in France. She was the eldest daughter of a shoemaker and a seamstress, a small household that survived on a tight budget. Although Jeanne received no formal education, she learned to read and write. Despite her humble beginnings, she was a girl of great curiosity and big ambitions.

When Jeanne was 18 years old, she firmly set foot on a course to Paris to become a dressmaker, traversing the long road of more than 400 kilometers.

In this global hub of culture, fashion, and the arts and sciences, the young woman was exposed to society as she had never seen before. Her long journey had taken her to a place abounding with ideas of innovation and sophistication; she was not only broadening her horizons as an intellectual mind, but also expanding her aspirations as a young woman of no fortune or name.

As a seamstress assistant, over the course of a few years and thousands of dresses, Jeanne found a small name for herself in her exquisitely intricate work. She gained national renown as the crafter of the Italian Princess Caroline's wedding gown. The commission brought her into high society, where she met and married English merchant James Power.

In the City of Light and Love, Jeanne had stepped into a world of golden opportunity, and found romance, too.

The newly-wed couple moved to the harbor-city Messina, on the island of Sicily, where Jeanne devoted her newfound time to her studies. She pursued reading works of geology and natural history, and in the mild Mediterranean climate, her enjoyment of the outdoors moved her to explore the island's natural landscape.

This is where the paths of Jeanne and the Argonaut would cross.

As Jeanne carefully observed the flora and fauna of Messina—collecting samples and making sketches as a self-taught artist—she found herself near the ocean time and time again. Often, Jeanne would walk near to the shoreline, and soon enough, she found herself wading into the waters themselves, pulling her long skirts in with her. It was there that she encountered the Argonaut for the first time.

At the heart of the Argonaut's intrigue was the mystery of her shell—for centuries, it had been discussed why only the females of her species had a shell, whether she had created it herself or had obtained it from another (like the hermit crab), and how she could possibly detach from the object unlike any other mollusk. But given her evasive nature, all struggled to crack the Kraken's code.

Now, faced with this mystery, Jeanne was determined to uncover the secrets of the Argonaut.

Unlike those who had come before her, as well as her male contemporaries, Jeanne soon came to the realization that it was unlikely that she would be able to discover the true origin of the Argonaut's shell by studying preserved specimens. She needed to observe the living mollusk itself.

So she put her skills of innovation to work, first creating offshore systems of cages (some of the world's first offshore research stations), and eventually developing the glass aquarium in 1832. In her home-turned-laboratory, Jeanne was able to bring home live specimens of the Argonaut to observe.

The Seamstress and the Mystery...

One day, she was amazed to see that a baby Argonaut was building its shell in front of her own eyes. It was concrete evidence that the Argonaut indeed formed its own shell, and nearly from birth, too.

As Jeanne continued her experiments, she asked a question that no one had considered before: what would happen if she pierced the shell of the Argonaut?

From there, she discovered that not only could the octopus repair its shell using its own substance (forming a scar-like patch), but also by using external objects, or "spare parts." Others had declared it impossible before, but here was undeniable proof of the astonishing engineering abilities and intelligence of the Argonaut.

An unbelievable and unprecedented discovery.

★★★

Jeanne's inventions, her experimental process, and her discoveries had changed the landscape of marine biology forever. Perhaps it is fitting that the female Argonaut's mysteries were only uncovered by a woman. And like that creative little Argonaut, whose delicate shell had stood unchanging even against a millennia of change in the world, Jeanne's innovations stood to serve generations past her own research and experimentations.

Let both of their stories be an inspiration to young female scientists, researchers, and inventors, and a testament to nature's wonderful and creative mind.

★★★

French seamstress-turned-scientist Jeanne Villepreux-Power was the pioneering inventor of the aquarium and its systematic use for studying marine life. As a cephalopods researcher, she was able to prove that the Argonauta argo creates its own shells. Villepreux-Power was the first female member of the Catania Accademia Gioenia.

★*The argonaut, despite its popular nickname of "paper nautilus," is NOT a nautilus. Instead, it is a type of pelagic octopus, specifically a member of the genus "Argonauta."*

—Lily Yao, age 16, Sophomore, SEHS, Oregon.

Second Place: Marian Diamond

Every time you learn something, your brain changes. It could be a skill, a problem you solve, or just getting through an unfamiliar experience. During any of those, your brain builds new connections, or strengthens old ones—especially if the new skill is repeated. Today, we know this happens at any age, not just through adolescence. It also should continue throughout life, to enrich the brain and keep it healthy as it ages. For this knowledge, we can thank one of the scientists who suggested the idea in the 1960s and changed the way we think of the brain: Marian Diamond.

Diamond was born in Glendale, California on November 11, 1926 as Marian Cleeves, the last of six children. Her father was a physician, and her mother had previously taught Latin. Diamond grew up with her family in La Crescenta, and when later asked to describe what kind of child she was, according to her autobiography, she always replied "very independent." Though her siblings were often afraid of their strict father, Diamond was not, and was usually nominated as the one to ask him if they wanted something. Her bravery became especially valuable later in her professional life. Diamond's mother, who regretted not continuing her education and job, encouraged her to get and keep a profession, even after having children, something she ended up doing. Before that, of course, there was her education: Diamond attended Glendale High School and Glendale Community College before transferring to University of California Berkeley, where she eventually became the first female graduate student in the anatomy department. Post university her achievements only continued.

Since the time she saw a human brain at the Los Angeles County Hospital while with her father at age fifteen, Diamond knew what she wanted to study. She was in awe that the three-pound organ had such incredible potential, later calling it "the most miraculous mass of protoplasm on this earth and perhaps in our galaxy." After her degree, she researched at Harvard, became the first woman to teach science at Cornell University, and finally returned to lecture at Berkeley. During this period in the early 1960s, she worked with a research group to find evidence of brain plasticity, her idea that the brain could change (and improve) with

experience. She researched with rats, giving one group toys and companionship, and leaving the other without. The enriched group consistently showed cerebral cortexes that were 6% thicker. When the experiment was done over a longer period of time, the enriched rats lived longer. Eventually, Diamond's breakthroughs in brain plasticity cemented her as a founder of modern neuroscience, though they were controversial at first. Other scientists in the 1960s were opposed to her ideas. Previously, it was believed that the way the brain grew was genetic and fixed after a certain point. Diamond challenged this with her evidence, and she changed neuroscience.

After her neuroplasticity breakthrough, Diamond continued to research and teach. She first showed the differences between the cerebral cortexes of male and female animals in 1983. Later in the 1980s, she added to her neuroplasticity research with experiments on older rats—the results still showed that environment matters. She believed we should take advantage of neuroplasticity to continue sharpening our brains as we age, suggesting five points: diet, exercise, newness, challenge, and love! Additionally, Diamond studied Einstein's brain, and found more glial cells than average. This paved the way to the new study of glial biology, changing the idea that glial cells "did nothing." Diamond was not only a scientist but a teacher. She worked at UC Berkeley for over half a century, where she was a beloved and inspiring professor, known to carry a preserved brain around in a floral hat box and joke with her students: "When you see an old lady with a hatbox, you never know what's going to come out!"

In Diamond's lectures, many students were women. But this was not the case when she was in school. At that point, few women entered science at all. In the 1960s, the scientific community could be misogynistic. Once, when presenting her research at a meeting of hundreds of people (mostly men), a man stood up after her talk, yelling "Young lady, that brain cannot change!" Diamond was confident about her work and replied simply that both her experiments showed it could. Still, criticism was common. "It was an uphill battle for women scientists then—even more than now." Diamond wrote in a book she coauthored with Janet Hopson in 1998, Magic Trees of the Mind. According to Gary Weimberg, who made a film about her, she faced a lot of challenges because of her gender. Besides the amount of skepticism, she sometimes had her name left off of research papers. However, he said she didn't like to talk about it—she wanted her focus to be science. That was her job and passion. Still, Diamond was proud of her achievements as a woman, and she inspired many others to follow in her footsteps. One student, Wendy Suzuki, said that the day she saw Diamond unveil her hat box brain was the day she decided she wanted to be a neuroscientist—and she did.

Throughout history, women have been discouraged from participating in science. The general belief for hundreds of years was that women were intellectually inferior, which even Charles Darwin wrote. Even as it was disproved, the precedent it set remained, and women are often not credited for their work, or excluded from doing it at all. Though it is much better now than it has been, we should acknowledge the bias instead of ignoring it, so we can continue to work on ending it.

Marian Diamond is only one example of great women in science—there are many others, even if they weren't well-known. The number of women in science will only increase, as we learn more about these role models who paved the way for girls today.

—Olive Passaro, age 17, SEHS, Eugene, Oregon.

Third Place: Orange Peels

When most of us see orange peels, we see trash. The more environmental among us might see the potential for compost. Some might even see the potential for a bittersweet treat called marmalade.

But when Karia Nirghin saw orange peels in 2015, she saw the opportunity to solve food insecurity driven by one of the worst droughts in South African history.

When the drought hit, Karia was a 16-year-old schoolgirl in Johannesburg, South Africa. She remem-

bers vividly the first time that she was confronted by the devastating effects of the drought. As her family began a road-trip across the nation, she saw the beautiful land, usually so lush with life, crumbling beneath their tires. She drove past wildlands whose ground was so brittle that all wildlife had fled from lack of food. She drove past farms, their dry, rocky soil unable to produce much more than a few feeble crops.

There was a tangible sense of hopelessness as Karia drove through the drought, and Karia could feel it creeping into her bones. The dry wind seemed to whisper softly in her ears, *there's nothing you can do.*

What could she accomplish if even scientists and professionals had cowered in the face of such destruction?

But what if I just try?, Karia muttered to herself. When she got home, the images of drought were still fresh in her mind. Karia pulled out her laptop and began googling ambitious questions, like *how to stop a drought?*

The googling led down rabbit-hole after rabbit-hole, each solution seeming as impossible as the next. Meanwhile, many people were still hungry for food that South Africa's drought-stricken farms couldn't produce.

Someone had to come up with a solution!

Kiara's determination to help others was sparked three years earlier, when she contracted a severe case of life-threatening bacterial meningitis, taking her out of school for months. She became consumed by issues affecting her nation—issues like rhino poaching, education, food insecurity, and drought. When she had recovered from the infection, Kiara had a new determination to make her nation a better place.

And so, that day, Kiara was researching drought solutions. She clicked on an interesting-looking website about something she had never heard of before—a material called super absorbent polymers, or SAPs.

As Kiara soon found out, SAPs are like little sponges that can absorb hundreds of times their weight in water—the stuff used in diapers. When SAPs are applied as a powder on soil, they absorb and store the water that would otherwise run off, creating minuscule pockets of water that can be used later.

The only problem, it seemed to Kiara, was that SAPs were unenvironmental and expensive. The chemicals degraded the soil, and the price point made SAPs inaccessible to struggling South African farmers.

The solution seemed simple, obvious even. All she needed to do was create an environmental, cheap version. Kiara could feel hope returning to her like a breath of fresh air, as she began reading academic journals on the subject.

At a molecular level, SAPs are made up of long strings of polymers shaped like coils. When dry, the polymers coil tightly together taking up minimal space. But when wet, they uncoil and expand to absorb hundreds of times their weight in water. SAPs also contain essential gelling agents to store the absorbed water as a gel.

As Kiara soon realized, SAPs are made up of everything that orange peels happen to naturally contain. Kiara felt her blood rushing in excitement.

Snatching an orange from the kitchen table, Kiara hurriedly peeled it. Her hands trembled as she carefully grated the pithy crust.

With a fine powder of orange peel, Kiara wondered what she should do next. Should she bake it? Boil it? Leave it out in the sun? How could she avoid damaging its delicate internal structures?

And so the months of experimentation began. Kiara tested every method she could think of, yet each failed experiment chipped away at her excitement. Maybe it wasn't so simple. Maybe she should just give up and leave the experimenting to the scientists.

Each time, the orange peels seemed to hold the water for only a little while, before releasing all the water, without forming a gel. The pectin wasn't working, and Kiara was out of ideas. She felt like giving up.

In later years, after Kiara had won many prestigious awards for her invention, she reflected that, "coming back after a failure is as important as trying in the first place."

So as her orange peel mixtures failed, Kiara didn't give up. Months later, she looked around her kitchen counter again. Her eyes lingered on an avocado that was beginning to over-ripen in the fruit basket.

What if I use the oil in an avocado peel to bind together the orange's polymer coils? With significantly less of the excitement she had felt at the beginning of her experimentation, Kiara grated up the avocado skin and added

it to the solution, sighing. This was her last idea.

Kiara carefully poured water onto the powder. Her eyes widened. It was working! She couldn't believe it: the water had gelatinized into a smooth, thick mixture, just like it was meant to.

With newfound excitement, Kiara tested it against commercial, chemical SAPs. Incredibly, her invention was even more effective at retaining water. The invention was so simple that farmers could create it themselves out of common household food waste. And it could improve food security tremendously.

With her invention of a biodegradable super absorbent polymer, Kiara didn't single-handedly end a drought. She didn't solve climate change. And yet, her inspirational determination created a simple solution where even professionals had failed.

When most of us see a natural disaster or other complex issue, we feel powerless. The more compassionate among us might feel an illogical pang of guilt. Some of us might even turn our eyes to ease the pain of compassion.

But what if we weren't afraid to try?

—Anna Dillon, SEHS senior, Oregon.