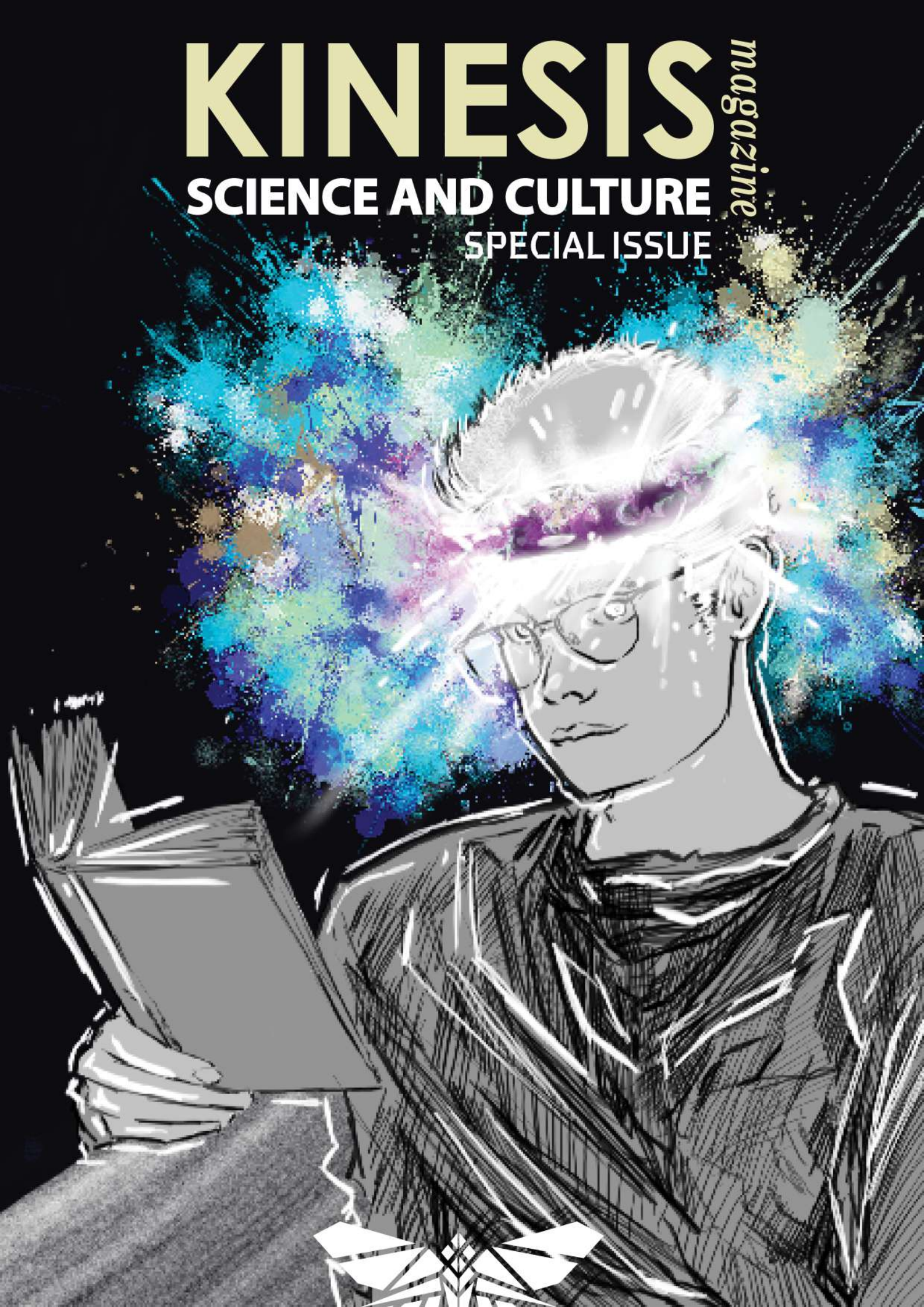
KINESIS

magazine

SCIENCE AND CULTURE

SPECIAL ISSUE



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A LETTER FROM THE EDITOR

As the second term of the year now comes to an end, we are excited to present Kinesis Magazine's 3rd special issue! Term 2 is always a busy time, juggling ever-accumulating deadlines with club and society elections, but a huge thanks to the committee and all of our writers, editors and artists for still contributing to this issue!

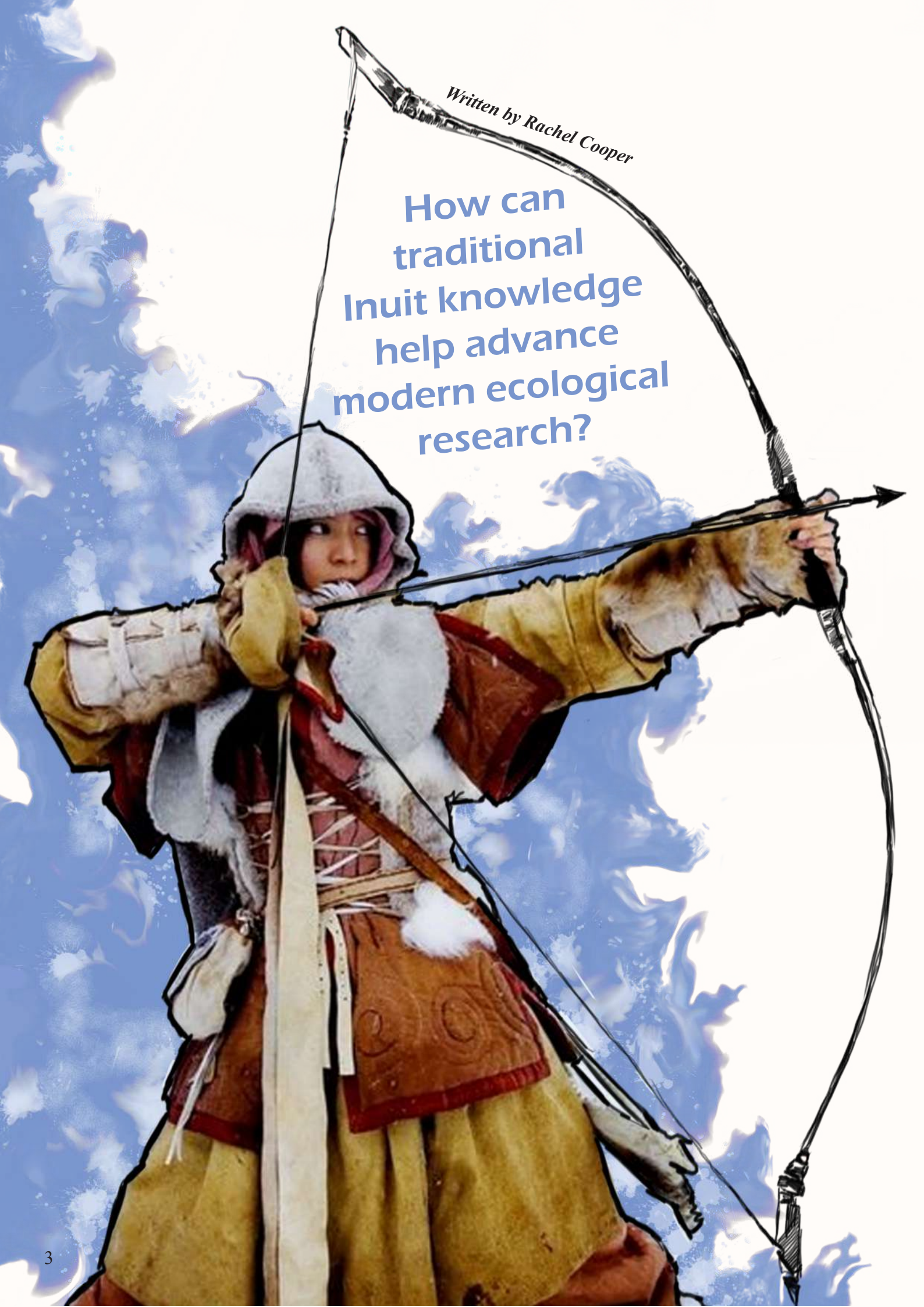
By tradition, our second issue of the year is always a themed one, so when I was asked to decide on a theme, I wanted one that I could look back on and feel proud of choosing. In all honesty, it didn't take too long to decide on a topic, as I had one in mind from the moment I was elected into my position as Managing Editor, being the intersection of culture with science.

As someone who comes from a family who only emigrated to the UK from India in the year 2000, I have lived my life trying to share my culture from a young age. This varies from bringing in sweet treats at Diwali, to wearing a kurta (Indian traditional outfit) to my school's no-uniform day and even presenting to my primary school class on how much British colonialism took from India. When given a outlet like Kinesis Magazine, I naturally wanted to use the chance to expand on my fascination with both science and the world's cultures, and give people a platform to do so with me. I am so grateful to the team behind this issue for helping me realise this ambition, and to all of our writers who have helped build such a holistic issue, which truly examines so many aspects of the words 'science' and 'culture'.

In today's world, the relationship between science and culture is more important than ever. Science has an impact on our daily lives in countless ways, from the medicines we take to the technology we use. At the same time, culture influences how we view and interact with science, shaping our perceptions and expectations.
In the ensuing pages, you will find articles exploring how Maori knowledge can better inform western science, an interview with a renowned psychotherapist on body cultures, and even a first hand recount of ecological fieldwork in the jungle of Guyana! While giving an issue a theme on one hand limits creativity, I truly believe that this is a theme which simultaneously has allowed for immense freedom for our writers and artists to delve into their life experience or their interests.

Once again, I wanted to thank our committee for their tireless work in putting together this issue which means so much to me, and of course, thank you to our writers, editors and artists- we couldn't have done it without you!

Nirvan Marathe
Managing Editor



Written by Rachel Cooper

How can traditional Inuit knowledge help advance modern ecological research?

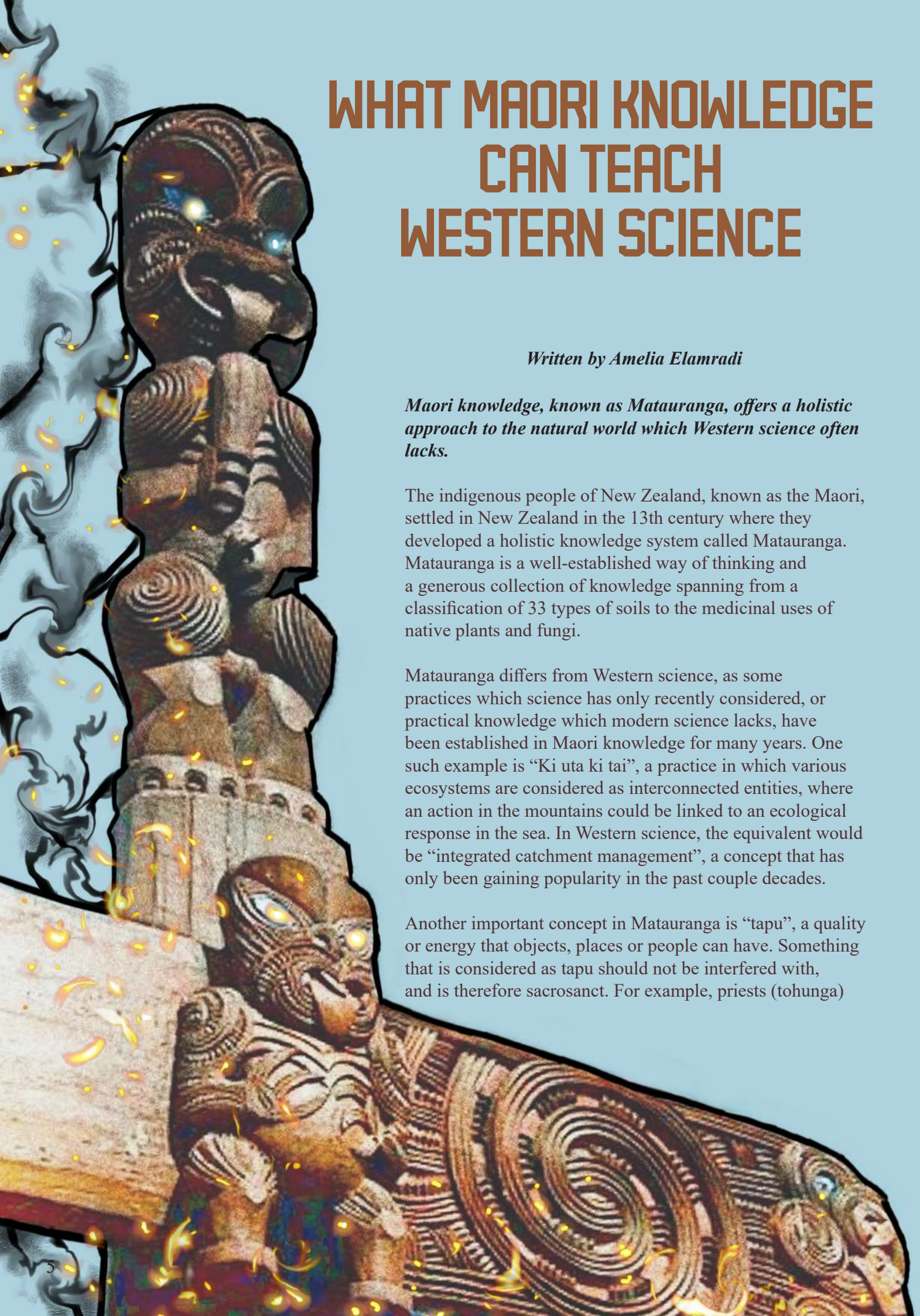
Science is often dominated by Western cultures. We have the most funding and resources, and research follows a carefully tailored and structured process. However, it doesn't represent the different perspectives on nature from cultures all over the world. Limiting our perspective of science may hinder our progress, since we don't understand the traditional belief systems of indigenous populations. This article focuses on one indigenous culture in particular, the Inuit, who inhabit the Arctic and subarctic regions of Greenland, Arctic Canada, Alaska and Far East Russia. They have a rich history of traditional environmental knowledge, which has been passed down through generations. Their unique knowledge of the natural world sources an integral part of their cultural identity, and we could use this knowledge for scientific advancements. It may be the key to protecting biodiversity and achieving sustainable development.

Scientists have used their knowledge in the past to help with their research, and its importance is slowly being recognised. In one example, environmental researcher Shari Gearheard worked with Inuit hunters and elders to examine changes in weather patterns. They agreed the difference between their research methods "brings a completely different emphasis both in defining what the important scientific questions are, and discerning how to address them". Members of the Inuit community were able to predict the weather with a unique set of skills, but their ability is becoming weaker as the climate changes. By sharing stories of these changing patterns with researchers, they had enough information to analyse their reports. They found a significant decline in temperature persistence in May and June, which aligned with Inuit stories of unpredictable weather variations during this time.

Inuit's traditional ecological knowledge of animal behaviour along with other natural processes, such as ice conditions, is also invaluable for scientists. Their knowledge of bowhead whale behaviour, dating back thousands of years, was shared with Western scientists, who were able to enhance this knowledge with modern technology. Cross-cultural efforts in this study allowed a special understanding of whale behaviour and population changes, and researchers were able to develop sustainable whaling practices that were respectful of the Inuit culture while conserving a threatened species. Furthermore, knowing the seasonal resting places of walruses is common practice within the culture. In recent years, the Inuit have experienced changing environmental conditions and less predictable walrus migration patterns. This observation was shared with Canadian researchers to develop their study of the migration behaviour and distribution of the species.

Despite the benefits, there is a danger that using Inuit knowledge to our advantage will lead to power dynamics between science practices. Arctic research is often rooted in colonialism, with an academic mindset that privileges the interests of Western institutions and fails to address Northern societal needs. Therefore, while it is good to learn from Inuit cultures for our scientific research, we also need to see more Inuit research coming from themselves. There seems to be a credibility gap between Western and Inuit knowledge, since many people believe their 'science' is just myths and stories while the former comes from evidence that is collected and analysed. Inuit traditional knowledge is known as 'Inuit Qaujimajatuqangit' (IQ), which encompasses all aspects of traditional Inuit culture, including values, world view, language, social organisation, knowledge, life skills, perceptions and expectations. This highlights the difference between IQ and Western understanding of traditional knowledge, as IQ represents a different way of knowing from centuries of practice. Inuit hunters in particular must be Arctic scientists, wildlife experts, and water and ice researchers to survive; they need this traditional ecological knowledge to examine variations in climate and prey behaviour to catch their food. Therefore, this knowledge is arguably just as important as modern science from Western cultures.

As the use of indigenous knowledge is becoming more recognised and used in research, people are seeing the benefits of explaining complex systems with traditional approaches. However, we should encourage Inuit scientists to contribute their own work to address the issue of Western supremacy. A wide range of research from both indigenous and Western cultures, as well as cross-cultural studies, will provide an immense collection of knowledge and perspectives that will better equip us for the fight against the world's biggest environmental problems.



WHAT MAORI KNOWLEDGE CAN TEACH WESTERN SCIENCE

Written by Amelia Elamradi

Maori knowledge, known as Matauranga, offers a holistic approach to the natural world which Western science often lacks.

The indigenous people of New Zealand, known as the Maori, settled in New Zealand in the 13th century where they developed a holistic knowledge system called Matauranga. Matauranga is a well-established way of thinking and a generous collection of knowledge spanning from a classification of 33 types of soils to the medicinal uses of native plants and fungi.

Matauranga differs from Western science, as some practices which science has only recently considered, or practical knowledge which modern science lacks, have been established in Maori knowledge for many years. One such example is “Ki uta ki tai”, a practice in which various ecosystems are considered as interconnected entities, where an action in the mountains could be linked to an ecological response in the sea. In Western science, the equivalent would be “integrated catchment management”, a concept that has only been gaining popularity in the past couple decades.

Another important concept in Matauranga is “tapu”, a quality or energy that objects, places or people can have. Something that is considered as tapu should not be interfered with, and is therefore sacrosanct. For example, priests (tohunga)

would protect resources from over-exploitation by declaring important resources such as a fishery as tapu. This concept is reflected in conservation today, but where the Western world is only recently realising the importance of conserving natural resources and wildlife, the Maori have embedded this concept into their lifestyle and culture.

While Western science is beginning to adopt practices analogous to those of Matauranga, there is debate questioning its status as a science. Some refer to Matauranga as a science, and yet others would argue that Matauranga is a knowledge system in its own right and does not involve the experimentation and hypothesis testing that the scientific method is defined by. Yet, this does not mean that Matauranga is irrelevant to science. The Maori's holistic approach and practical knowledge of New Zealand's ecology is something that scientific research can benefit from, and allows the Maori to have a voice in research.

Maori knowledge has made great contributions to New Zealand's scientific research. One significant example is in the conservation of the endemic tuatara lizard. Tuataras are the last living member of its taxonomic order, so it's important to conserve this order before it falls victim to extinction. Tuataras have become extinct on New Zealand's main island, and only remain on the offshore islands. Researchers were able to interview elder Maori, who had knowledge on the tuatara's physiology, diet, habitat and more, confirming the scientist's existing findings. Maori knowledge, in addition to known recent habitats of the tuatara, allow for more effective conservation of the species. Additionally, there have been many other projects which have involved Maori contributions such as the identification of a new active compound originating from a native plant that could potentially prevent a deadly disease in the kauri tree species. Maori's deep knowledge of various wildlife across New Zealand acts like a "compass" to science, paving the way towards helpful discoveries.

The involvement of Maori in research would suggest that their knowledge is respected in science and society, which is certainly the case across several fields and practices. New Zealand's government has recently introduced Matauranga to the national curriculum, establishing its "equal status" to subjects traditionally taught in schools. They've created resources for schools to use and even ran a "roadshow" to spread awareness of Matauranga through activities and events across the country.

However, there is progress to be made when it comes to the integration and respect of Matauranga. British evolutionary biologist Richard Dawkins has described Matauranga as "myth", not science, which may be a consequence of a superior view of Western science in which Maori, despite their deep knowledge, are excluded. Another shocking perspective was revealed in a recent study in which Maori female scientists were generally regarded as "impossible fiction".

The future perspectives on Matauranga and potential Maori involvement in science remain uncertain. A future where Matauranga is acknowledged as a rich and complex knowledge system and used to inform science that benefits everyone is an ideal future. Western science can learn a lot from the Maori's approach and way of thinking, so a combination of these differing approaches could create holistic and well-informed science. However, problems may arise in attempting to create this ideal scenario since indigenous people shouldn't be "used" for their knowledge if people continue to disrespect and discredit them. Hopefully, Maori and their Matauranga become a respected knowledge that is used to inform research to meet a shared goal: protecting Earth and improving the lives of the people and wildlife who inhabit it.

PRAY FOR SCIENCE:
Attitudes towards Science amidst religious cultures in Africa

Written by Obomate Briggs
Art by Irina Pirvu

Since the birth of modern science, the compatibility, or lack thereof, of science and religion has been the source of contentious debate. Through the dawn of the Enlightenment era, the use of meta-religious language to describe science increased, with science, in its supposed objectivity, acting as the epitome of realism. Metaphorically, religion represented the sword of Damocles to science, a looming threat and hindrance to its hierarchy and development. Various scholars have argued that the two concepts will forever be at odds, but is this legitimately true? Can science and religion ever coexist?

Much research has been produced regarding how religious beliefs can shape perceptions and attitudes towards science. However, it has primarily taken place in Western contexts and broadening our understanding of the science-religion dynamic requires consideration of how different global perspectives and cultures affect religiosity.

Africans are amongst the world's most religious people, with members of these populations engaging with various cultural authorities such as traditional and indigenous African beliefs alongside Western beliefs—thereby creating a unique case to study the potential conflict between science and religion. Contrary to public opinion, new research focusing on the attitudes to science in countries such as Nigeria, Zimbabwe and South Africa has revealed that the relationship between science and religion is not such a zero-sum game.

The conflict hypothesis is one of the research paradigms used to describe the relationship between science and religion. Essentially, it reinforces the idea of an intrinsic intellectual conflict between religion and science that ultimately leads to hostility. In line with this thesis, a study investigating the relationship between science and religion in South Africa suggested the following research question: What proportions of South Africans agree that religion is always right whenever science and religion conflict?

The data showed that, in South Africa, 76% of respondents agree that religion is always right, 64% in Zimbabwe, 38% in the US and 12% in Germany. While the mean value for the importance of God in your life (religiosity) is 9.69 in Zimbabwe and 8.08 in South religious Africa, comparatively to

4.41 (lowest) in Germany. Nevertheless, results show that the influence of religiosity on the conflict variable is significant across the four countries but is much stronger in Germany and the US than in African countries. Findings reported from this quantitative approach are, somewhat, in line with the often-stated conflict narrative. However, this is limiting as it is formulated to foster the conflict narrative. It is biased through its binary choices of 'Agree' or 'Disagree', forcing the respondent to disregard the dynamic subtleties of the science-religion relationship.

This outright rejection of one or the other is an assumed response to our 'cognitive dissonance'; the perception that these supposedly conflicting concepts make us 'psychologically uncomfortable', that we yearn for our minds to be in accord with our existing knowledge. An expression of this state can also lead to hierarchical beliefs, the elevation or demotion of religion (or science) relative to the other, which offers a more nuanced perspective through some form of coexistence. This was further explored through the qualitative analysis of the South African study, in which semi-structured face-to-face interviews were conducted using open-ended questions. For example, researchers asked the question: 'Are there ways in which scientific knowledge conflicts with your beliefs (such as faith or religion)?', qualitatively elaborating on the previous question.
The qualitative study shows some respondents did not feel any psychological discomfort, debunking the supposed universality of the dissonance theory. Rather, they seemed comfortable living with both forms of knowledge, either in a parallel (i.e., addressing different aspects of life) or in a complementary relationship (i.e., one enhances the experience with the other). Or, alternatively in a transformative relationship in which they both transform each other through the ability to be 'weigh[ed] against the other'.

According to psychologist Moscovici, this phenomenon is s a display of cognitive polyphasia where different forms of knowledge possessing different rationalities live side-by-side in the same individual or group. Having faith in both forms of knowledge was also found in Nigeria, a fellow African country where most respondents expressed similar levels of faith in science and religion.

Although 88% of Nigeria's 174 million population agree that religion is always right, cognitive polyphasia was prevalent in this research, particularly in the statistical interaction of scientific knowledge and religion when considering evaluative attitudes to science. Like the results found in South Africa, it defines cognitive polyphasia into three categories: hierarchical, complementary but parallel, and empowering. On both ends of the religious spectrum, individuals engaged with science and religion with differing consequences. Those with high religiosity were in shock and awe of science, alluding to the complementary cognitive polyphasia, in which the wonders of the physical world reflect a wondrous God. The more conventional believers were more realistic, less optimistic, and less fearful about science as their knowledge increased.

Of note are the variable dimensions that require acknowledgement of their effects on the interaction between science and religion and how this can differ culturally, such as the social aspect. In South Africa, social trust is a discriminator between African countries and more advanced economies, whereas increased education, as seen across these countries, is a negative predictor of the conflict hypothesis. While in Nigeria, there is evidence of cognitive polyphasia in patterns of trust in different actors. Therefore, those who trust the scientist will also trust the religious leader and, to some extent, other state actors but not politicians.
aThere is a heightened need for more research into the relationship between religion and science in Africa and other non-western countries, as studies support the idea that cultural differences may exist within this interaction. Our understanding of the complex problem of science and religion in Africa is advanced by such studies, particularly the South African study that integrated two different approaches: the quantitative and the qualitative. Thus, highlighting a discrepancy in the narrative between the scholarly popular conflict thesis and people's true, regular interactions with science and religion.

So, can science and religion ever coexist? It appears as though they already are.

An individual can, at times, express the different knowledge forms by professing faith in the two statements of 'truth' in the same context. This research suggests that faith in science is not necessarily radically different from religious faith. They are, after all, driven by the same concept.

Breaking the Cycle of Tradition: The Fight against Female Genital Mutilation

Written by Daniela Pamias
Art by Laila Kandil

Whether it is political or scientific remains unclear, but the fact that it is a disaster is for certain. The most systemic form of torture, yet in some cultures it is still a rite of passage for young girls. Not a single health benefit, yet over 200 million women today have undergone the procedure. A complete violation of women's, children's and human rights, yet every 10 seconds at least one woman undergoes Female Genital Mutilation (FGM). A stark representation of the deep-rooted gender inequality and violence against women, with over 80% of cases occurring in Africa. It is not just a women's issue, it is everyone's issue and it must be addressed immediately.

What is FGM?
FGM is a practice where the female genital organs, often of young girls, are cut or injured without medical reasoning. There are several types of mutilation, from removal of the clitoris (clitoridectomy) to the suturing of the vulva. It is often done by a traditional practitioner with very limited training using a single shard of glass on multiple women. No anesthesia is available for those undergoing female circumcision and the conditions make it impossible for a sterile environment, putting the woman at risk of various bacterial and viral infections. Despite these circumstances of severe pain, these women are encouraged to be 'brave' and hold back their tears so that they don't bring shame upon their families.

Where does it come from?
FGM is believed to have originated in multiple locations and been spread through the routes of slave trade to western Africa. Initially established to segregate the different social classes, it represented the commitment of families with younger girls to men of a higher socioeconomic background. Today, FGM is primarily practiced as a rite of passage for women into society and to conserve virginity until marriage. In simple terms, it is a measure to control female sexuality and heavily perpetuate the existing inequality between sexes. FGM has been reported in 31 countries - predominantly in Africa, the Middle East and Asia. As the global population continues to increase, if global efforts are not put into place, by 2030, 68 million more girls will be at risk of FGM.

Medical disaster:
First and foremost, there is not a single health benefit, only harm, associated with FGM. Its medical implications cannot go unspoken and persist for the entirety of the victim's life, causing significant morbidity and mortality. Above all, pain is a major life-changing consequence of this medical malpractice. Pain is a personal experience, which can be influenced by numerous genetic, social and psychological factors. FGM-related pain originates from damage to the vulvar and clitoral area but also from resulting infection and inflammation of cysts. Chronic pain syndrome is commonly reported in victims, who suffer from the sensitisation of pain transmission fibers in the affected area. This causes these fibers to be activated at lower sensory inputs thus, pain persists in the long term. Excessive bleeding and a heightened risk of HIV infection from damaged vaginal endothelium are a few others to add to the long list of immediate health consequences, which in extreme cases, also ends in death.

The increase in obstetric complications during childbirth as a result of FGM is extremely problematic in a society where reproduction plays such an important role in determining the value given to a female. Women who have undergone FGM are twice as likely to experience birth-related difficulties. The narrowing of the vaginal opening from FGM means childbirth is difficult without an episiotomy (a surgical procedure to widen the vaginal opening by cutting the area between the anus and the vagina). Some mothers even experience perineal tears without intervention from the healthcare provider to allow for the labor.

Furthermore, it goes without saying that this traumatic experience leads to multiple psychological problems which severely impact the women's well-being, namely, post-traumatic stress disorder (PTSD). This mental health condition comes from experiencing or witnessing the mutilation and is characterized by symptoms of intrusive thoughts, hyperarousal and flashbacks. Victims who underwent the procedure during childhood or adolescence also reveal impaired sexual development due to the plastic nature of their nervous system at the time of the event.

With so much emphasis given to health in the modern day, why is this practice still tolerated?

Political disaster:
The continuation of FGM in the modern day is a complex issue tied to many political factors. This procedure perpetuates patriarchal societies and impedes the progression towards equality. Mutilation is culturally believed to improve hygiene, on the basis that female genital organs are 'unclean', and increase male sexual pleasure, making it a condition of marriage of girls in certain regions. This practice is thought to preserve 'cultural identity', with victims and their families threatened with exclusion from society if they are not mutilated. Notice not a single one of these beliefs benefit the woman whatsoever, and all demonstrate the deep-rooted desire of improving male satisfaction at the expense of basic women's rights. It is this deep systemic sexism which drives the dehumanizing belief into practice, and widespread awareness, education and discussion are vital to put an end to it.

Above all, lack of education is a key factor fueling the alarming cultural acceptance of this tradition. In areas without the privilege to quality education, the lack of awareness of the medical impacts prevents the movement into a new cultural norm. Despite its recognition as a clear abuse of human rights, this issue is deeply ingrained on a cultural level and therefore intervention is needed from within the communities affected. Although mutilation is considered a Class E felony in the U.S., the regarded cultural significance of this practice poses a barrier against the political drive to enforce a law against it, so the issue remains unchallenged.

FGM is much more than a political and scientific disaster. It reflects the underlying sexism and subordination of females to a point where their basic rights have been completely violated. In a generation moving towards gender equality, it remains an indisputable priority to educate and empower women to break the chain. Emphasis must be redirected to allow women to change their attitudes around the practice and place them in a position where they can make choices about their own bodies and futures. This cycle can only be broken once they have the power and support to address the root causes, namely gender-based violence, poverty and discrimination.

THE NATURAL BODY IS A FICTION

- an Interview with Susie Orbach -

Written by Leonie Hellwich

I had the honour of meeting Susie Orbach in her residence in North London to ask her some questions concerning her most recent book Bodies, which deals with body image, transforming bodies, and the subsequent impact on our sense of self. Having worked as a psychotherapist, psychoanalyst, and journalist and after publishing several books, she has always been very outspoken about directing attention towards emerging psychological patterns and their underlying causes. She especially focuses on women's issues and how their needs are being addressed in therapeutic settings.

As she explains, her involvement started with the emergence of second wave feminism in the 1970s. Orbach's academic interests aligned with fellow students of the women's studies program, specifically with how women internalised patriarchal structures. She explains how, alongside her fellow researchers – particularly Luise Eichenbaum and Carol Bloom –, she then started to "think about emotional development, how we needed to refigure the psychoanalytic canon, and how we needed to look at the themes that were particularly perplexing to women - whether it was their relationship to bodies or their relationship to insecurity or envy or competition or jealousy or anger." Patriarchal structures were found to be concrete structures inside of people as much as the concrete structures outside.

Dismantling those structures and increasing the public's awareness of their impact has since led her to cofound The Women's Therapy Centre (1976) with Luise Eichenbaum and to publish literature enabling the public to understand the cause of emerging women-specific issues (see Fat Is a Feminist Issue) and the realities of therapy (see In Therapy).

In terms of the causes of a developing body-mind disconnect, she describes that the turning point came by examining the structural role of the mother and the roots of associated feelings. Orbach argues: "She [the mother] is culture. […] She doesn't instruct us in culture. She didn't instruct us to be messed up about our body. She didn't instruct us to do anything, but her own experience of living in a particular historical moment or a class background or racialized situation would be who she was, and therefore it would be in the very early mother-daughter relationship."

The significance of such early influences becomes apparent in her encounters with patients, she illustrates how she believes body and mind are absolutely connected: "The legacy that therapists come into is that the mind trumps the body. But my experience of the last thirty years is that body troubles are trumping mind problems." According to Orbach, the impact of bodily issues goes far beyond the patient's body in therapy; "Therapy impacts the person, the therapist, and they will, of course, have to think about what that impact is. But that impact is also on therapist bodies, not just on their minds." In Bodies, Orbach gives examples for therapy sessions that affected her physically and how in certain sessions from the therapist's viewpoint, one can feel as if they are holding the person's pain and sharing their bodily discomfort.

What she frequently highlights is how our bodies and our body image are shaped by how they are treated in childhood by caregivers. One striking example found in Bodies is the story of Gina and Wendy, who develop a very unique relationship that illustrates how bonds are shaped by bodily interactions in real-life. As Gina was adopted by Wendy at the age of ten, they struggled to develop a body-to-body relationship from scratch. Recognizing the importance of this early contact inevitably leads to the question whether its lack can be overcome and whether it is possible to heal from traumatic separations or missing physical intimacy over time. Here, Orbach emphasises the role of therapy as a tool to discover and question oneself and one's relationships: "I believe healing is maybe not the right word, I think what therapy does is address things. It finds ways of not hiding and, […] finds ways of recognizing and acknowledging some of the hurt or disjuncture or the awkwardness

or defensiveness […] and in that process can undo some of the defence structures that come about so that a growth can occur. It [Therapy] is healing the responses to it."

Orbach describes recent developments concerning our relationship with our bodies as worrying. In light of recent, rapidly emerging issues of how bodily issues are treated for queer, trans or disabled bodies, Orbach agrees with a notion outlined in Queering psychotherapy by Jane C. Czyzselska which states: "Unregulated shame states are likely to constitute a disorganizing force in the bodyminds of children, for whom parts of self must remain hidden or split off particularly for those with multiple intersectionality identities." Respecting said identities is crucial to Orbach, which to her also means taking a stand in the debate about the Gender Recognition Reform which would enable trans people to legally change their gender without having to endure the process of obtaining a medical report. "I'm not up for the medical diagnosis. I'm up for self-certification. I'm not up for the age." She says about herself: "I totally know who I was at 16."

She continues to describe how society has undergone many changes since she started working in the field, developments that come with a greater range of opportunities but also potential downsides: "Now, there are so many categories of identities, a lot of labels and frozen. And they're very useful in the short term, but they're not so useful in the long term, in terms of development. […] So how do we have identities that are flexible and allow for differences, rather than saying this within them?"

Observing the role of the media, Orbach describes it as a rather ambivalent influence: "Has there been an increased variety of bodily portrayals? – Yes and no. That is the problem. The body is for sale, we live in late capitalism. It's still about display and not about living from a body." She identified the new technologies of the body as particularly problematic: "You can have a new heart, you can have a new labia…"

Taking in the complex beliefs we have internalised about our bodies and which Orbach describes as ultimately detrimental for ourselves and others; what lies within our power as an individual? What can be done to distance oneself and break free from them? Orbach's advice is simple but poignant. Trying to reject those ideas that we are exposed to, is a struggle and easier to face alongside others, within a group. She rejects the popular idea of body positivity: "It does not take into account the pain and the struggle (that come with this process)." Not acknowledging this will not help with overcoming and dismantling, instead she says goodbye on a rather uplifting note and leaves us with a reminder: "Allow yourselves to risk being in the bodies you have."

DOOMSDAY CLOCK COUNTDOWN: HOW MUCH TIME DO WE HAVE LEFT?

Written by Catherine Turnbull

Doom and gloom are plastered all over the news these days but how close to the end of the world are we really?

We've become numb to the endless news of how the UK is on the brink of recession, that we must act now against climate change before it's too late, and how it's only a matter of time before the next deadly pandemic arises. But scientists have a way to measure how close humanity is to the end of life as we know it…and it is known as the doomsday clock.

The hands of this hypothetical clock are determined each year by the Bulletin of the Atomic Scientists which resides on the Science and Security Board. This was founded by scientists such as Albert Einstein and Robert Oppenheimer after the development of atomic bombs during the Manhattan project. Once the hands reach midnight - it is the end of life as we know it.

The risk to society has become exacerbated since Russia's invasion of Ukraine, and now with the threat of nuclear weapons lingering in the air, the doomsday clock is only 90 seconds away from midnight. This is the closest the clock has ever been to midnight since it was first established in 1947. The furthest the hands have ever been away from midnight was at the end of the cold war in 1991 when the Strategic Arms Reduction Treaty was signed by both the U.S. and Soviet Union to limit the number of nuclear weapons. Back then the clock was at 17 minutes to midnight.

It's not just nuclear threats that can harm society. Another man-made problem has persisted to damage our feeble existence: climate change. In 2007, the clock was moved to 5 minutes to midnight due to the threat that climate change can inflict upon the future of humanity.
Putin's war has since prevented global efforts to combat climate change due to the cut-off of Russian oil supplies. Since then, many countries relying on such resources have had to expand their searches elsewhere. This led to the uptake in the use of natural gas rather than limiting it; thus, further contributing to global warming.

Countries across the globe have agreed to help limit global temperatures to 1.5 degrees Celsius - as set out by the Paris Agreement in 2015. This is a legally binding decision undertaken by 196 different parties - the first time a multicultural effort has been united against climate change. Although this temperature change seems minor, this tiny increase will have a dramatic effect on weather patterns across the world, leaving many less developed countries the most vulnerable.

As sea levels rise, less land is available to house our ever-growing population of 8 billion people. More severe weather will become common, creating floods, famine, and destruction. We saw this last year with floods in West Africa and Pakistan, whilst Europe experienced a heat wave that led to poor harvests, which increased the already exacerbated food prices from the ongoing conflict in Ukraine. This is why governments around the globe must act now on this real threat which has only been taken seriously within the last few decades. With the G7 summits of the world's most economically influential countries meeting annually to discuss global issues - including supplying

Ukraine with military aid and combating climate change - let's hope we never see the results of the planet heating up more than 1.5 degrees Celsius.

By the beginning of 2020, the clock reached the closest it had been to midnight up until that point: 100 seconds remaining. This was before the COVID-19 pandemic became a global emergency.

The pandemic was and still is the epitome of unprecedented times, completely changing our lives overnight, a true measure of what the doomsday clock represents. The pandemic particularly highlighted which countries were more equipped to adapt to the biological threat of a new human disease. This should be a wake-up call for more privileged countries to help those who struggled in the early days of the pandemic since limiting the spread of the disease requires global collaboration. Moreover, the ease of the emergence of a category 3 biohazard should concern us and make sure that humanity is better prepared for the next one.

With the ongoing conflict in Ukraine nowhere near resolution, the future use of bioweapons is a real possibility. Pathogens that cause fatalities or life-changing disabilities are obvious targets for such use. The inconspicuous use of anthrax (Bacillus anthracis) is a prime example of this ever since its spores were posted ominously through letters delivered to U.S. senator offices in 2001 after the 9/11 attacks. The bacterium spores were in powdered form, allowing for inhalation - leading to the deadlier form of the disease. With many diseases being zoonotic, infecting both animals and humans, there are plenty of carriers for such diseases. As our population encroaches on natural habitats, our interactions with animals will increase, through hunting, farming, and trading at wet markets - risking the transmission of a new zoonotic disease. Thus, global surveillance of newly emerging diseases is vital for preventing them from becoming a future biological weapon.

Overall, the presence of the doomsday clock itself isn't to induce fear-crippling anxiety into us as we picture a ticking time bomb ready to explode and strip us of our future at any moment. But instead, it is to be taken as a clear objective measure for governments to determine how close our society is to a self-inflicted disaster - to act now before it's too late. It is a time for reflection, to see how much damage humans are capable of, and a reminder of how just because something can be done doesn't mean it should be. If anything, the doomsday clock shows how a united effort is required from every country to make a difference. Restoring peace and safety to everyone, along with kindness to the environment, is vital for the future of our survival. It shows that we cannot move forward unless we all move forward together, building a future for everyone.

Evolution: Is it a secular religion?

Exploring the boundaries between culture, religion and science

Written by Aiyi Mian
Art by Qiwen Liu

How did humans and the organisms around us arrive at their current forms? Upon a question like this, an atheist evolutionary biologist and a believer of a certain faith might respond very differently. This is particularly evident in the matter of evolution, a scientific theory that explains how species change over time through natural selection and genetic variation. In comparison, religion typically offers a creation story based on a supernatural creator or divine force.

While some religious beliefs may conflict with certain aspects of evolutionary theory, it is still possible for individuals to hold both religious beliefs and accept the scientific theory of evolution. However, many scientists have insisted on an untainted ideal of what contemporary evolution, and ultimately science, should be - free from cultural and political debate. This forms a phenomenon where evolution may serve as a "secular religion" for some, but it is crucial to realise that religions, politics, and cultures are ultimately inseparable from the production of knowledge in the scientific community.

The Past: Catholic and Protestant Science

The Protestant Reformation, which occurred in the 16th century, is a prime example of the impact of religion on the conduct of science. While Catholicism would have placed a high value on authoritative figures such as the Priest and his interpretation of the Bible, protestantism promoted an ethos of doing good deeds and making the world a better place. This meant that Protestantism might have moulded an individual who is better suited to the development of capitalism.

In response, the second part of The Merton Thesis assumes that the rise in popularity of science in the late 17th century can be largely attributed to ascetic protestantism's values. This should be accompanied by its first part, which simply states that changes in 17th-century science were due to improved experimental methods and an accumulation of experimental results.

Despite their differences, both Catholicism and Protestantism have had famous scientists. Take the example of Catholic scientists like Georges Lemaître, a priest who proposed the Big Bang theory, or Nicolaus Copernicus, an astronomer who proposed the heliocentric model of the solar system, and protestant scientists like Michael Faraday, a physicist and chemist who made important discoveries in electromagnetism and electrochemistry, and James Clerk Maxwell, a physicist who formulated the theory of electromagnetism and made important contributions to our understanding of colour perception.

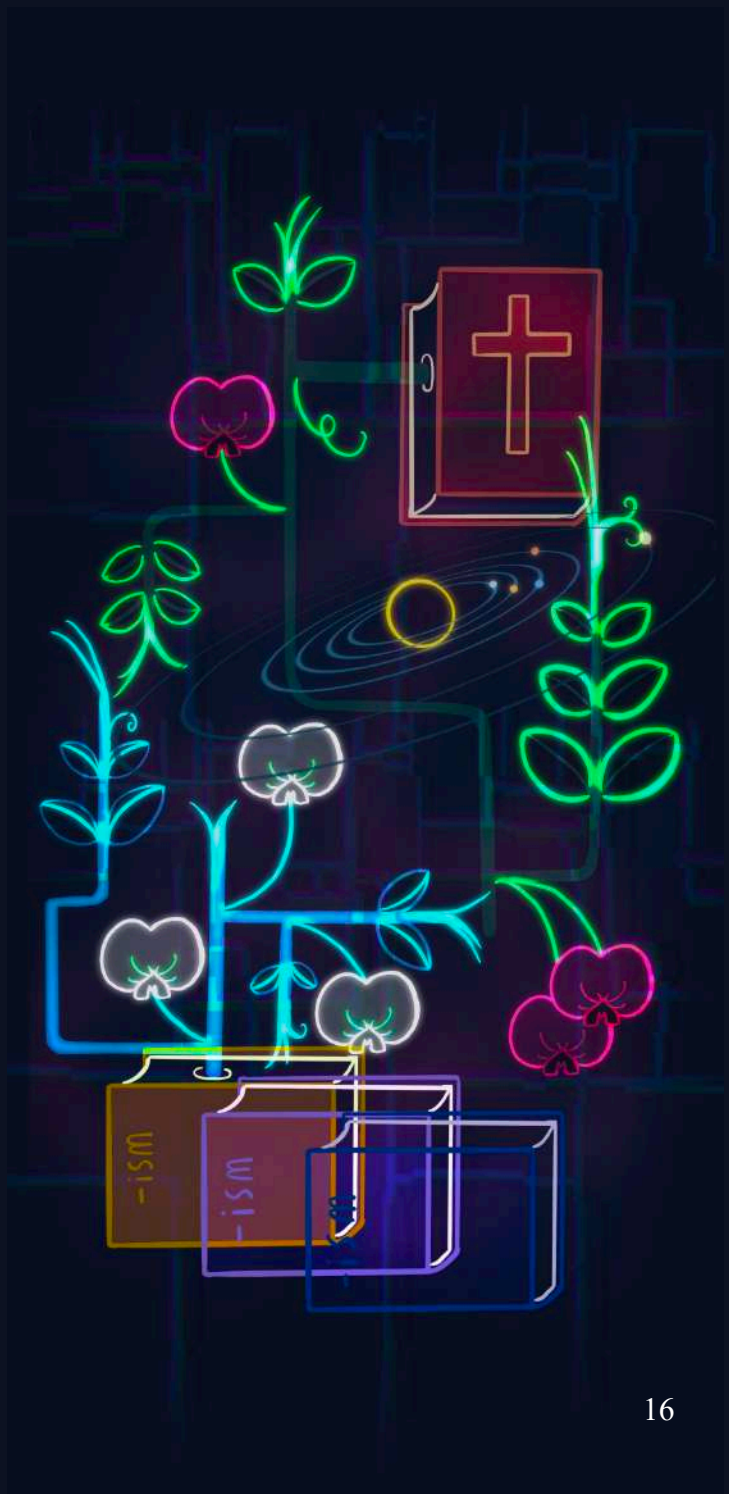
Nonetheless, a scientist's religious beliefs can impact their attitude towards science in various ways, and it is important to identify such influences. An example of a scientist's work being motivated by religion is the 17th-century monk Gregor Mendel, known as the father of genetics. Mendel's work on genetics was motivated by his desire to understand the underlying principles of heredity, which he saw as evidence of God's divine plan for life. He believed that by studying the patterns of inheritance in pea plants, he could gain insights into the workings of the natural world and the mind of God. Mendel's religious motivations did not detract from the rigour and precision of his scientific work; his experiments were carefully designed and meticulously carried out, and his conclusions were based on empirical evidence rather than religious doctrine. However, his religious beliefs did provide a deeper sense of purpose and meaning to his scientific work and may have influenced the questions he chose to investigate and the interpretations he drew from his data.

The Present: Cultural and Religious Influences, Everywhere

Canadian philosopher of science Michael Ruse published an article that advocates for "pure science" that must be protected and taught without being tainted by political or religious influence. Ruse believes that "today's professional evolutionism is no more a secular religion than industrial chemistry", so that those who value science should distinguish between times when science is conducted and times when science is extrapolated from, particularly during teaching. However, by polarising science and religion like this, Ruse draws the same conclusions as though the "tainted" versions of evolution are a matter of the past and that science isn't affected by our cultures or religions anymore. That simply is not the case, even in the 21st century.

In the present day, conflicts between science, culture, and religion have led to debates on how science should even be taught. In the United States, for example, groups often with religious or conservative affiliations have opposed evolution teaching in schools, advocating for alternatives such as creationism or intelligent design to be taught alongside or instead of evolution.

Also, in a mini-series created by Nature in 2020, seventeen years after the publication of Ruse's article, Nick Howe from the Nature Podcast discusses the relevance of politics to a scientific publication like Nature. This is because Nature's story about the damage that Donald Trump has done to science has received several criticisms that have demanded that Nature "stick to the science", but is this correct? In their series, they suggest that "politics is deeply ingrained in scientists' working lives. Be it through funding agendas, cultural lobbies, or personal bias, politics can shape the game in myriad ways, influencing the direction and quality of research."



While it is still commendable to strive for objectivity and excellence in scientific research, we should not forget that a pure pursuit of scientific knowledge rarely exists without cultural, religious, and political influences. Such understandings are especially significant and relevant when approaching education, research priorities, scientific methods, ethical considerations, and other issues such as public discourse or acceptance of scientific findings. In the end, it's important to realise that the production of scientific knowledge and its effects have always been tied to culture, religion, and politics, and they should be talked about with care. In Stephen Jay Gould's words, "Nature is objective, and nature is knowable, but we can only view her through a glass darkly–and many clouds upon our vision are of our own making: social and cultural biases, psychological preferences, and mental limitations (in universal modes of thought, not just individualised stupidity)."

Oriental Medical Care:

How are traditions relevant in modern medicine?

Written by Ye Nay Htet (Henry)
Art by Emily Vials

Since ancient times, Mother Nature has provided an abundant variety of healing materials. Curiosity led people to understand the importance of nature's properties and history has shown that we have learned how to manipulate the complex mixture of phytochemicals and use them for our health and wellbeing. The documentations of these treatment modes in traditional medicine have led to major breakthroughs in the field of medicine such as novel drug discovery and its derivatives.

In Traditional Chinese Medicine (TCM), herbs play a crucial role. Each of them have their own unique preparations and modes of consumption, ranging from powders, balms, extracts, and soups; most of them involve consuming its compounds in a liquid form. The main concept for TCM is to restore the balance of the body by providing external and/or internal stimuli. One of the herbs is the white peony root (Paeonia lactiflora), called Bai Shao in Mandarin. It was considered a women's herb since its dried roots are brewed into tea or soup and consumed to relieve dysmenorrhoea, and menorrhagia - menstrual pain and excessive bleeding. Even an old Chinese proverb said: "A woman who consumes peony root regularly becomes as beautiful as the peony flower." Research found that paeoniflorin is the primary bioactive material in this herb (>90%) as it holds anti-inflammatory effects. It restricts the production of multiple inflammatory mediators: proinflammatory cytokines, nitric oxide, tumour necrosis factor-α and others, making it a suitable component to treat autoimmune diseases such as rheumatoid arthritis and lupus. In addition, paeoniflorin is also found to inhibit the production of interleukin-1β which is involved in cancer progression, meaning that it has a potential to provide future cancer medications.

You might (or might not) wonder: How are traditional methods still relevant in current society? Well, traditional herbal medicine is still being used and most of them are even under the UK/EU legal licence: "Traditional Herbal Registration". In addition, they have led to major discoveries. For example, Professor Youyou Tu uncovered a Chinese medical manuscript from 340 AD, which led to her winning a Nobel Prize for the malaria drug discovery. It was based on the sweet wormwood (Artemisia annua), referred as Qinghao in Chinese. The book stated to take a handful of qinghao drenched in two litres of water, straining out the juice and drinking it all. Prof. Tu and her team structured their research on this remedy, by trying to extract the active compound in low temperature since the text does not mention heating. After multiple trial and error, they finally discovered the lead compound, artemisinin, which we now base to make malaria medicine. It is found that artemisinin reacts with iron to form artemisinin-derived free radicals which attack the Plasmodium parasites (causative agent of malaria). Conveniently, this parasite is abundant in hemozoin - an iron-containing pigment due to the digestion of haemoglobin leading to the parasite being exclusively targeted.

As for physical therapies in TCM, it mainly relies on the philosophy of regulating the body's energy "Qi", in which TCM believes that imbalance of Qi is what causes infirmity. For instance, acupuncture inserts needles in specific parts of the skin and it is thought to orchestrate the spread of qi throughout the body. The proposed mechanism behind this method is caused by stimulating the nervous system to produce our own painkillers: melatonin and serotonin, proving its benefits by enhancing sleep and relieving pain. In addition, Gua sha, a method of scraping the skin, deliberately causing ecchymosis - bruising due to ruptured blood vessels on the skin, is said to even out Qi throughout the body to relieve pain and tension. The science behind says that it induces microcirculation which is beneficial for regulating blood flow and detoxification. These can be studied and developed to create innovative therapies that mimics this concept to apply in modern practice.

Outside of TCM, we can also learn from other cultures such as drum circles which have shown to improve mental and physical health. These herbal and physical remedies are still being practised in countries around the world, as well as among present physiotherapists and other healthcare professionals since they have proven to improve the lifestyles of people. It is important to preserve this knowledge and learn from it, especially the herbal, since it is a known fact that some of the major drugs such as aspirin, morphine and many more originate from nature. It is just a matter of further research and development to expand our resources for medicine and integrate sophisticated ancient practice with a modern point of view that will definitely inspire the next generation of drug discovery and innovations.

The Avatar Agenda

A science fiction flowing in subliminal messaging

Written by Gracie Enticknap

Full of wondrous exploration and engaged questioning, science fiction is an immensely and imaginatively lucrative narrative artistry that plays with the science and technology of the real world. Creators take cognitive leaps to extrapolate and invent enriched fictional worlds and complex societies which creatively breach the current limits of our own and run at a tangent to reality through the introduction of a 'disruptor.' This might be vastly improved interplanetary travel, capitalisation of off-world resourcing, colonisation of other planets, or some imagined (but perhaps scarily possible) event like fatal destruction and resource-draining of the Earth. Any one of these are examples of hinges used by storytellers to make an analytical social or political point about innovation and prods at the opportunities, hopes, fears, and questions in our society. You might notice that all these ideas are present within James Cameron's Avatar franchise, which uses ecological issues as a backbone to link recurring elements of social collapse, technological change, and environmental degradation as they cause humanity to encroach on a world of stellar beauty and balance.

At its forefront, Avatar is a visually stunning biofiction acting at the intersection of colonialist war tropes, climate fiction, and biopunk (a subgenre of sci-fi focussed on biological technologies), and is abundant with mesmerising landscapes, lush forestry, and majestic creatures. The films are set on the distant fictional moon of Pandora in the Alpha Centauri galaxy; where humanity has travelled, in the original movie, on a mission to exploitatively mine a valuable ore in desperation to solve the global energy catastrophe on Earth. The expeditive intentions read as an alien invasion movie, where we are the aliens, scavenging resources and investigating the flora and fauna to understand the mystical, intimate connectivity between the native life on Pandora. This set-up is combined with the complication of a toxic atmosphere, bringing in the hugely iconic biotechnology of the franchise – the human-Na'vi hybrid clones, or 'avatars,' through which people can upload their minds into surrogate bodies and move freely in the outdoors.

In the first movie, this technology sets in motion a story of corporate apathy, human violence, and immoral destruction as Jake Sully, a paraplegic ex-marine and avatar operator, is tasked with infiltrating a native clan to learn their customs and convince them to flee home to make way for demolition and resource extraction. Of course, not all goes to plan as the Na'vi are fiercely protective of their home and their land, and Jake's moral lightswitch finally flicks to aid the Na'vi and his newfound love Neytiri. After defeat in the first film, humanity returns in full vengeance in the second instalment, this time set on colonising Pandora to relocate from their dying and uninhabitable home, terrorising the people and poaching their animals for valuable resources - loud echoes of major ecological threats on Earth.

So in a visceral world – previously untouched by corrupt capitalist minds and self-righteous, entitled humans – Cameron promotes ideas of natural beauty, protection, and lifestyles more connected to nature, and contrasts them with the brutal damage humans cause and the monstrosities we're willing to enact by uprooting communities, draining resources and exploiting environments. His movies are a (bio) luminescent celebration of the beauty of nature, which presents extensive reflections on our planet, to urge pertinent points of climate action and persistent protection of the planet. This is a valid, if not one-dimensional commentary on global warming and resource exhaustion; but with his frontal elements

of planetary escape, natural exploitation, and human antagonization, Cameron attempts to make further commentary on particular social and capitalist responses to the climate crisis…

Avatar is, at its most skeletal layer, a story of escape. The human colonies escape from a dying Earth, from ecological disaster, from an energy catastrophe, and crucially, escape from the problems of their own making that have spiralled out of control. In the context of his interspecies, environmentally motivated war movie, Cameron is condemning human activity by criticising the morality of their technological advancement as a product of their response to an ecological crisis. This response is avoidant, and fails to confront their problematic business and lifestyle back on Earth. They evade addressing the root causes of environmental deterioration and resource-draining, in favour of escapist and fantastical solutions like conquering a 'planet B.' Cameron warns that if we act in a similar way, we won't be saved, and draws attention to the technological powers that influence the investment in climate action responses.

You might consider Cameron's condemnation of avoidant technological solutions analogous to the technological fixes invested in by big powers like the fossil fuel industry. Geoengineering technologies like carbon capture, where carbon is taken from the atmosphere for storage underground, and solar radiation management, which aims to cool the planet by reducing incoming radiation, are popular with oil companies and huge tech figures who dominate in emissions. But this isn't the eco-friendly move we should hope for, as they steal focus from environmental protection - it's a green-wash and a risky, technologically reliant, imperfect solution. However, they've gained some popularity in this sector because they target the environmental consequences rather than the sources of damage, providing an easy excuse to continue their damning business as usual. It's a final escape hatch to continue operation and in that a complete scapegoat solution, enabling denial of their huge responsibility for the ecological mess that has been made. It is this type of ignorance of the upstream changes needed that Cameron judges the morality of in his work, as it works to worsen climate change, biodiversity loss, and eventual ecological collapse.

But is such condemnation a commentary effectively made? In its sub-context, Avatar is about the harm of malicious ignorance and refusal to address the sources of environmental devastation through escape to space, but it presents a paradox. Despite being an earnest appeal to environmental conservationism, the visually mesmerising movies present a cosmic escapism that provokes a real-world dejection in some viewers who long for a world like Pandora. Rather than being motivated to engage with our world, people experience the malaise that the Earth is becoming further and further from the world of Pandora, which may be thus considered derogatorily utopian.

In a sense, Avatar acknowledges the political dilemma around climate solutions but fails to resolve the issues or imagine a better way forward. So, it makes a visually beautiful point about engaging with environmental protection and acting against technological fixes that are divorced from pragmatism and protection but does not offer any theoretical resolution to the problems explored. The enchanting world of Avatar shines a gleaming spotlight on lifestyles more connected to nature that value eco-friendliness, particularly inspired by indigenous peoples, but in reality, this admiration alone is no way to overcome the industrial and capitalist powers driving climate destruction.

Decolonising Science in the Caribbean

Written by Rachel Grosberg

While growing up in the Caribbean, I never questioned why for so many STEM students the natural progression of their education was to pursue tertiary education at a foreign university. Only now, as I learn more about the origin of the knowledge that is taught within Caribbean classrooms does it make sense that we would be influenced along this path. Science as it is known today, the science that is portrayed in the media and taught in schools as 'facts', represents a Western, Eurocentric model of science. Western Modern Science (WMS) rejects any other form of scientific knowledge, such as 'indigenous' science and 'alternative' medicine. The Global North refers to regions within the northern hemisphere that are considered 'developed' while the Global South refers to regions within the southern hemisphere that are considered 'underdeveloped'. The movement to decolonise science is an attempt to reinvigorate the scientific practices and beliefs of the original inhabitants of colonised nations as well as those specific to the local environment and people. This article focuses on decolonising science in Caribbean nations in an attempt to shift the focus within these regions away from western scientific literacy and towards scientific literacy that supports our own history, culture and environment.

Before discussing the decolonization of science in Caribbean nations within this 'post-colonial' world, the interconnectedness between science and colonialism must be acknowledged. Science was simultaneously an empirical justification and a tool for colonial expansion. Furthermore, the exploitation of Caribbean islands for their resources fueled scientific advancements within England and Europe. The close bidirectional relationship between science and colonialism is a major reason for the Eurocentric bias within science today.

The recency of emancipation, independence and/or becoming a republic for many of the Caribbean nations has not afforded them much time to develop, hindering their global involvement in many sectors. Additionally, the exploitation of these previously colonised Caribbean islands for their natural resources has 'delayed' their development of a stable economy (Sanders, 2007). In fact, some Caribbean islands, particularly saddening is the case of Haiti, have never been able to recover, largely due to the plight of colonisation (Sanders, 2007). The resultant economic boost experienced by the United Kingdom and Europe afforded them an abundance of resources for advancement in all sectors, accrediting them as 'developed' nations. Due to historical colonialism and neo-colonialism, many Caribbean nations have been forced into importation rather than industrialisation, slowing development and innovation, and forcing Caribbean islands to largely remain consumers of science technology (Boisselle, 2016).

A major issue of WMS is its limited socio-geographical reach. Popular scientific journals, conferences and funding opportunities are disproportionately accessible to countries of the Global North, leaving the Global South disconnected from potential opportunities. Another major issue with research conducted by researchers of the Global North is the frequent exploitation of partnerships with researchers in the Global South (Flint et al., 2022). Decolonising science calls for accountability and inclusion by Global North scientists when engaging in research with Global South scientists.

From a very young age, students in the Caribbean are unintentionally taught that WMS is the only form of scientific literacy, which prompts many students to idolise going to foreign universities in the US, UK and Canada for their tertiary education rather than attending Caribbean universities. Ultimately this leads many tertiary educated Caribbean citizens to immigrate to these more developed countries to work, a concept often referred to in the Caribbean as the "brain drain" (Sanders, 2007). Moreover, the science taught in Caribbean schools tends to be quite general, often "copied and pasted" from the successful educational models of more 'developed' nations, such as the UK. Decolonising science in the Caribbean calls for the science curriculums to be modified and taught according to the context of the local environment of the nation (Boisselle, 2006). This might mean having local, interactive scientific practices and investigations, allowing students to become more familiar with unique national issues and develop ideas to tackle them. This will help bridge the gap between what is taught in schools and real-world applications within the local environment. To a large extent school curriculums have been modified by the Caribbean Examination Council (CXC), mainly for subjects outside of STEM, but I believe a greater effort could be made to teach the science of our own local cultural practices and beliefs. To decolonise science, science education must expand to include 'indigenous' and 'alternative' science in Caribbean classrooms, teaching it as a form of scientific literacy. Science is different in every area of the world, similar to geography, culture or language. Therefore, students should be taught about the science of their people and their land to prepare them for participating in the research within that same environment, otherwise they will attempt to apply the scientific theory of another land to their own, encountering discrepancies in the process.

Western Modern Science can been implicated in some particularly horrific global tribulations alongside colonialism: pollution from industrialisation and the current climate crisis; racial, ethnic and class disparity evident in advanced medicine; over-medicalisation of conditions and the resultant mass drug consumption, addiction and avoidable death; loss of humanity and mental health crisis through technology and social media; racist initiatives such as the Eugenics movement and the Holocaust. To be clear, this article does not seek to neglect all the many benefits associated with WMS, it is simply unveiling its associated negative implications, which are not discussed enough. This article aims to educate readers about the reality of WMS as it is taught in the Caribbean, and offer different ways of being, knowing and learning, including those termed 'indigenous' and 'alternative'. These are just as legitimate and deserving of recognition as WMS. This article is a call to continue decolonizing science in the Caribbean, a topic which I feel particularly passionate about. To learn more about this topic "Decolonizing Science and Science Education in a Postcolonial Space" by Laila N Boisselle, "The Commonwealth Caribbean and the new colonialism" by Sir Ronald Sanders and "Colonialism and Science" by the University of Glasgow are a great place to begin.

Science in India: Navigating the Complex Intersection of Culture, Politics, and Progress

Written by Atufa Shabnum

The intersection of politics, culture, and science in India is a complex one, where each of these factors plays a crucial role in shaping the country's scientific landscape. India has a rich scientific heritage and is home to some of the world's oldest universities and institutions of higher learning like Nalanda University, University of Calcutta, and the Indian Institute of Science. In recent years, however, the country has faced several obstacles in its quest for scientific advancement, with political, cultural, and societal forces at play. What is the state of scientific progress in India, and what challenges do these factors represent?

Limited political backing for scientific research is a major issue facing India's scientific community. Although the government has boosted financing for science in recent years, defence research is still the priority. The latest budget included ₹23,264 crore (approximately £2.3 billion) for India's Defence Research and Development organisation, but only ₹16,361.42 crore (approximately £1.6 billion) for The Ministry of Science & Technology, making up only 0.36% of the Union budget. Fundamental scientific research, such as in biotechnology, or genomics, is less politically palatable, so is left underfinanced. This is perhaps because in India, there is often a tendency to focus on short-term goals over long-term investments. Scientific research typically requires a significant investment of time and resources before yielding results, which is less politically appealing for leaders looking for quick wins. Additionally, political decisions frequently lack a solid scientific foundation, overlooking investments into research that could inform policies. This, in turn, limits the ability of scientists to conduct meaningful research. For example, India is particularly vulnerable to the effects of climate change, including rising sea levels, more frequent and severe heat waves, and changes in monsoon patterns, which could have significant economic, social, and environmental consequences. Despite this, politicians consistently fail to prioritise research into the specific impacts of climate change on India, which could inform more effective policy solutions. While there are some research efforts underway, such as the Indian Network for Climate Change Assessment (INCCA), the level of investment and resources does not meet the scale of the challenge. Without robust scientific evidence, it is difficult for policymakers to make informed, effective decisions. This limits not only the ability of scientists to carry out meaningful research, but also the ability of India to effectively adapt to the impacts of climate change.

Another major challenge is cultural attitudes toward science, where ancient wisdom and modern science often clash. Belief, faith and superstition in India may have greater influence over public perceptions of science than scientific rigour and methodology itself. For instance, despite a dearth of scientific proof to back their usefulness, traditional medications and home cures are widely used in India. As a result, scientists struggle to convince the public of the value of funding scientific research. For example, cow urine is an ancient traditional medicine believed to have numerous therapeutic properties. It is commonly used to treat conditions such as skin diseases, diabetes, and cancer etc. However, scientific studies find no evidence that cow urine is an effective treatment for any of these conditions. Despite the lack of scientific evidence and potential health risks, cow urine treatments continue to be widely used in India and are even promoted by some religious and political leaders. This highlights the importance of promoting safe, effective, evidence-based medicine and ensuring that reliable information about traditional treatments is widely available.

Poor scientific literacy among the general public is a further barrier to scientific progress in India. Many people do not understand the scientific method or the importance of evidence-based decision-making, fueling public apathy towards science. This can make it difficult for scientists to carry out their work and

for their findings to be taken seriously. In addition, a common lack of interest in science among young people makes it harder to attract the next generation of scientists.

Despite these challenges, there are many positive signs for the future of science in India. The country has a large and well-educated scientific workforce, with talented scientists across a range of fields. Additionally, there is increasing appreciation for the importance of science and technology in social and economic development. One example is the development of innovative medical technologies. Many Indian scientists and engineers have worked to create low-cost, portable ECG and ultrasound machines, which are improving access to healthcare for millions of people in rural areas. These technologies have been developed with the specific needs of the Indian population in mind, and they are helping to address some of the country's most pressing health challenges, including non-communicable diseases like cardiovascular diseases and diabetes.

Innovation in eco-friendly agricultural methods offers another example of how science has benefited India. Precision farming and water-saving irrigation systems are two sustainable technologies that Indian scientists and engineers have been developing to increase crop yields and improve food security. These technologies also promote sustainable economic growth in rural regions and reduce some of the negative environmental effects of agriculture.

Alongside these advancements, a number of recent policy changes by the Indian government are promoting scientific growth, including more funding for science and technology (although still not considered enough by experts), tax breaks for businesses that conduct research and development, and the opening of new research institutions, such as the Indian Institute of Science Education and Research (IISER) Berhampur. For example, the Science, Technology and Innovation Policy 2020 aims to create a sustainable ecosystem for research and innovation and to better connect science, technology, and industry.

While the scientific community in India faces several obstacles, such as a lack of political support and cultural beliefs that may impede advancement, there are also many encouraging signals for the place of modern science in the future of the nation. From low-cost, innovative healthcare technologies to sustainable technologies for agriculture, Indian scientists and engineers are making important contributions to the world and improving the lives of people in their country. There is still some way to go however, and pushing science and technology forward in India will require a concerted effort from all stakeholders, including the government, the scientific community, and the general public, to support and promote scientific research and development.

Repercussions of Neglecting Science

Written by Cansu Öktem
Art by Irina Pirvu

Growing up in Türkiye, my love for science was sustained by magazines from the nation's leading scientific research institute: TÜBİTAK (The Scientific and Technological Research Council of Türkiye). There has always been a lack of science resources due to the absence of scientific education in school, TV programs, or museums, and as a result, these magazines were one of few ways to be exposed to science. Today, TÜBİTAK has become another mouthpiece for the ruling party's conservative ideology, invalidating its scientific legitimacy.

The party has a strong anti-evolutionary stance, with their former minister of education insisting that the acceptance of evolution "can only exist within atheism", and that not teaching creationism in schools would be censorship. Since this statement, the government has banned evolutionary theory from school curriculums, and supported fabricated fossil exhibits to discredit evolution. Likewise, TÜBİTAK has increasingly adopted this anti-evolutionary stance. On the 200th anniversary of Darwin's birthday, a planned issue featuring articles dedicated to Darwin was banned by TÜBİTAK, the articles were removed, and the editor-in-chief of the magazine was fired by the vice president of TÜBİTAK. For over a decade, every TÜBİTAK president has asserted that evolution is only a hypothesis that continues to be debated, requiring scientific encyclopaedias translated into Turkish to reflect this uncertainty. Furthermore, they halt the translation of scientific books that mention human ancestors or evolution. Evolutionary biologists receive nonexistent or restricted funding, and many are blacklisted. Fear of retaliation is so common that many Turkish academics have developed a habit of self-censorship.

Evolution is not just an arbitrary theory. During the pandemic, we witnessed evolution in real time as new variants of COVID-19 evolved and triggered new surges of cases. Modelling the evolutionary patterns of viruses is key to predicting disease dynamics, issuing proper protocol, and importantly, developing vaccines. Since COVID-19 vaccines were based on the spike protein, a region that is key for antibody recognition, any new variants that evolved mutations in this protein could evade antibodies generated for the original strain. Bivalent boosters, which contain both Omicron and the original strain, strengthen the immune response against variants. Studies have found that newer variants of COVID-19 caused more deaths than the original strain, which "has virtually gone extinct". Thus, delivering boosters and continuing to follow lockdown protocol under the spread of new variants was essential to keeping the pandemic under control. However, viral mutations and boosters rely on a fundamental understanding of evolution. Although scientists are well-versed in evolutionary theory, the general public in Türkiye is not. While the Minister of Health declared that "the third dose of [Sinovac] could be beneficial", neither him nor the Turkish Medical Association explained the importance of boosters. In fact, he added that "there is absolutely no such medical necessity" for a third dose for those who already had two doses of BioNTech.

Lack of understanding creates anti-vaccine sentiment. In surveys conducted in Türkiye, over one-third of participants had negative perceptions of the COVID vaccine, and yet this number decreased among those who had received university education. Ironically, the founders of BioNTech and the vaccine were two Turkish scientists who were raised in Germany. But because teaching evolution in Turkish schools is banned, explanations of different variants and why boosters are important are not accessible to those without a university education. Hesitation about vaccine administration is a matter of life and death.

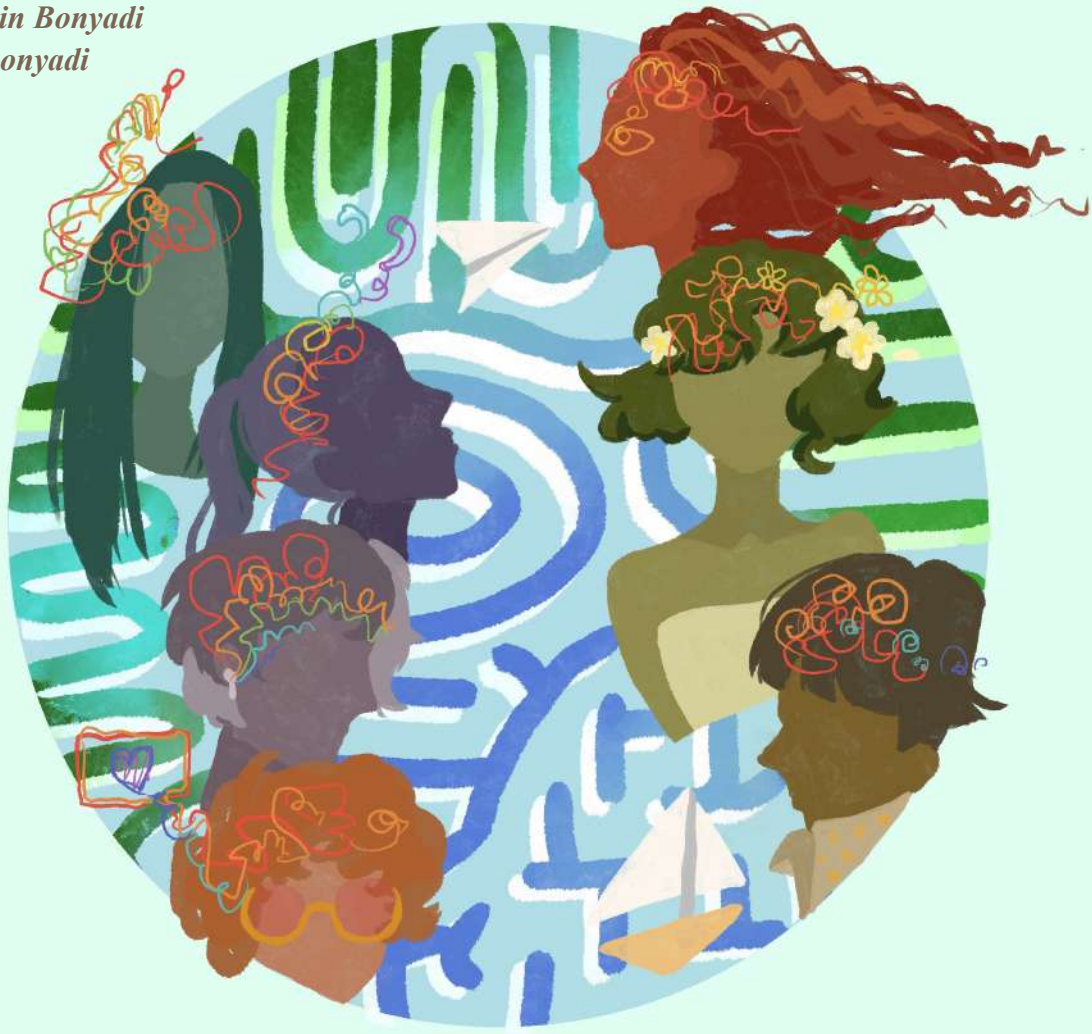
In reality, my reason for writing this article has nothing to do with TÜBİTAK, evolution, or even COVID itself, but the recurring trend of power grabs leading to utter carelessness with human lives. As tens of thousands remain trapped under the debris following the utterly devastating earthquakes, the government is continuing to underplay the scale of the disaster. They even blocked Twitter to hide their own incompetence, even though the platform is instrumental to the coordination of rescue efforts. Rescue operations have shifted from finding survivors to recovering dead bodies. The scale of this tragedy is immeasurable, and I am struggling to communicate the extent of the pain that the people of my country feel.

Türkiye has always been a hotspot for seismic activity. Geologists, seismologists, engineers, professors at prestigious Turkish universities, scientists within and outside of Türkiye, and every qualified person has been warning the government for numerous years to improve the quality of the infrastructure. There have even been papers from 2017 and 2019 published on this very subject.

After an earthquake in 1999 killed over 18,000 people in Türkiye, the administration at the time created a national earthquake council, pledged to improve building quality, created building-free evacuation spaces, and designated an earthquake fund from taxes. After more than 20 years of preparation, the money, which would have amounted to about £3.8 billion, has been spent on construction only benefitting the ruling party, the evacuation spaces have been sold to corrupt developers in cahoots with the government, the council dissolved many years ago, and the buildings have not seen one shred of improvement: the rubble can attest to this. Despite all the tools that science has provided to make our cities and our buildings earthquake-prepared, construction remains locked behind corruption. When science is not taken seriously, neither is the safety of people.

Culture Shock: How Brains Differ Across Cultures

Written by Elin Bonyadi
Art by Elin Bonyadi



Whether it's smashing plates at a wedding or taking a nap at noon, people around the world have been brought up in very different cultures, with different experiences that have been shaped by these cultures. As well as influencing the customs we engage in, these cultural differences shape the way we speak, think and act. They mould our views of the world and how we interact with one another. With these clear differences in behaviour between cultures, can cultural differences also be seen at the brain level?

A key cultural difference established in research is that Western cultures tend to be more individualistic, meaning they focus more on the self as an individual, whereas Eastern cultures are more collectivistic, focusing more on the collective good and their part within a social context. This difference has been cited as a possible reason for differences in how Eastern and Western cultures view and process information such as visual scenes. For example, eye tracking studies have found that East Asian participants focus more on the relation between a focal object and its background by flicking their gaze between them, whereas Western participants focus more on the focal object. Differences have also been found in how faces are processed in these different cultures, with East Asians being more likely to focus on a central region of someone's face, whilst Western participants were more likely to scan the face, with a specific focus on the eyes and mouth. But are these differences apparent within the structure and activity of the brain?

In a study conducted in 2006 which showed such cultural differences in brain function, Gutchess and colleagues measured brain activity in Americans and

East Asians as they viewed pictures of an object alone, a focal object within a background, and a background with no obvious focal object. Whilst they did not find group differences in activity in context-processing regions, they found that American participants had greater activity in object-processing regions compared to East Asian participants. The finding that Western participants' brains focused on processing individual objects more than those of East Asian participants is consistent with the individualistic-collectivistic hypothesis, as the hypothesis would predict that Americans focus more on the individual alone than East Asians do. This suggests there are some cultural differences in brain function, even in a process as fundamental as processing a basic scene.

Additionally, research has found that the brains of people from different cultures also respond differently in social contexts. For example, in research by Sui and colleagues in 2009, the difference in brain response when viewing pictures of one's own face compared to a familiar person's face was different in Chinese compared to British participants. Similarly, in 2007, Zhu and colleagues found that Western participants had greater activation in the medial prefrontal cortex – a region associated with self-representation – when making judgements about themselves compared to when making judgements about their mothers, whereas this difference in activation was smaller for Chinese participants. These findings suggest that Chinese participants differentiated much less than Western participants between themselves and their mother in this brain region, and that mothers were also represented (along with the self) in this self-representation region in Chinese, but not Western, participants. These findings are in line with the idea that Eastern cultures have a more collectivistic, interdependent attitude, and that such differences in cultural values are reflected in neural activity. Interestingly, research by Chiao and colleagues in 2009 even found that the strength of participants' individualistic or collectivistic views modulated levels of activity in this self-representation region when thinking about themselves and others. Another study, by Sui and colleagues in 2013, which primed Chinese and British participants with views that were opposite to that of their culture (independent for Chinese participants, interdependent for British participants), found that this priming led to a weakened effect of the responses that would be expected for the cultures. This suggests that the values participants hold, which would usually be instilled in them by the culture in which they were raised, may be a causal factor in these differential brain responses.

As well as changing how our brains function, research has shown that our long-term experiences even lead to structural changes in our brains. Compared to functional differences, there has been much less research on potential anatomical differences in the brain across cultures. However, some research has pointed to structural differences between East Asian and Western participants in various brain regions. In 2018, Tang and colleagues found that some temporal cortical areas were larger in Han Chinese participants than in Caucasian participants, whereas some regions of the cortex in frontal and parietal areas were smaller in Han Chinese compared to Caucasian participants. Nevertheless, without further exploration, it is difficult to say what such structural differences mean, as having a brain region that is larger than another person's does not on its own tell us what this means for behaviours that may be linked to that region. Unlike in functional studies, in which participants might complete a task testing a certain behaviour while their brain activity is recorded, we cannot link brain structure measures with a specific task or behaviour, or with proficiency in that task. Establishing the specific cause of any structural differences is also difficult because different cultural groups will differ on factors such as diet and properties of the language they speak, as well as cultural values, which may also impact structure.

While this field has produced some interesting findings regarding potential differences between cultures in the brain, many studies have focused on the same cultural groups for their comparisons, namely East Asians versus Westerners, making the findings very specific to differences between this narrow range of cultures. It would therefore be interesting to see whether such differences are also apparent between other cultural groups and whether any other differences are found.

So, when we go on holiday and explore different cultures, seeing the different customs and cuisines they have to offer, it is interesting to remember that these cultural differences are not just found at the behavioural, observable level, but also deep within the brain.

Where Math and Culture Collide

Written by Imani Stone

In the early aughts classic Mean Girls, protagonist Cady Heron states that her favorite subject is mathematics because "it's the same in every country", to which the other characters marvel in awe at her poetic answer. But, in actuality, how true is Cady's proclamation of universal mathematics? Does it differ between cultures? What can these differences and similarities tell us, and what does this mean for the future of mathematics? This is what the field of ethnomathematics investigates.

The official definition of "ethnomathematics" was developed by Brazilian mathematician Ubiratan D'Ambrosio in 1977, and has gone through refinement over the years. But it can be read as "the mathematics which is practiced among identifiable cultural groups such as national-tribe societies, labor groups, children of certain age brackets and professional classes" (Cimen, 2014). As pointed out in this interpretation of cultural groups, it can refer to ethnicities, but it can also mean cultural sub-groups of society; for example, bankers, and carpenters may utilise and view mathematics differently. Culture dictates much of our lives, ethnomathematics is one way of analyzing its influence.

While it may be true that every culture uses math, it is not used in the same way, starting from the basis of where we gain our numerical knowledge. For instance, different languages may use different base numbering systems. In English, we use the base 10 system. Essentially, this means that we break down our numbers in intervals relative to the number ten. However, there are a few languages that use base 12 as their number system, including Chenang in Nepal, the Nimbia dialect of the Gwandara people of West Africa, and even the Ancient Egyptians. The Mayan and Aztec people used base-twenty. Furthermore, some languages of Central New Guinea use base twenty-seven as their number system. French, interestingly, combines base ten and base twenty as their counting system. These linguistic nuances impact how speakers of these languages count, which is then important for understanding the basics of how numbers are viewed.

From counting systems, we can incorporate how math is used through culture. In fishing villages of Panay, Philippines, fisherfolk use algebraic and geometric concepts as part of their daily chores, though it may not be obvious for those lacking knowledge of the culture. For example, a kaba-ong is a hexagonal woven bamboo basket used for drying shrimp. It is weaved in a pattern incorporating hexagons and equilateral triangles. To produce the basket, the weaver employs symmetry, quadratic patterns, and basic arithmetic to ascertain how many bamboo strips needed. Even for tools of play, mathematical concepts are illustrated. The ariring is a toy windmill made of coconut leaves, and is often made for children using leaves cut into rectangles and folded into a windmill design. Notably, squares are an integral part of the design and reflect principles of the Pythagorean Theorem, a well-known hallmark in mathematics. For measurement of distance, length, and other metrics, body parts or easily identifiable and culturally relevant objects, like fishnet needles, are commonly used. This illustrates how formal math concepts are used in a practical and culturally specific manner; perhaps this is a case for the universality of math. But still, there is more to ponder when we consider how language shapes thinking, and therefore culture.

There are two Amazonian cultures that are linguistically anumeric, or lacking words for certain quantities. One of these is the Piraha people of the Amazon, who do not have the language to describe an exact amount above two. This means they have difficulty discerning the exact quantities above two or three, although they can visibly see the difference. Yet, when a more precise number system was introduced in the cultural context and language, they were able to change their thought process and means of communication, exemplifying the influence of language on our way of life, and our adaptability upon receiving new information. A mathematical concept as simple as naming and perceiving exact amounts is so heavily dependent on language, which in turn is an extension of culture. So while math exists in its most basic form, its cultural and societal needs dictate its use.

We have seen cultural integration of mathematical concepts, so what can this teach us about how we approach math education? It was D'Ambrosio's original belief that if students could tangibly see the practical value of mathematics in their daily lives and, importantly, in their cultural context, then more children would better understand the subject. This is illustrated with the fisherfolk of the Philippines: the mathematical constructs they use are part of their practical everyday life as opposed to the more abstract theoretical ways math is commonly taught in many Western countries. Incorporating more culturally relevant mathematics education may take a fair amount of time, simply because it requires the educators to have a confident and accurate grasp on the culture they are teaching; and therefore it requires more holistic training. But it could result in math education that is more relevant, applicable, and exciting to learners.

So, was Cady Heron right? Is math the same in every country? No, it is likely not. However she wasn't entirely incorrect. It does exist in every country and culture to some degree, so maybe we can confirm its universality in that sense. Still we must understand it and how it relates to specific cultures and subcultures. If acknowledged and applied, this can allow for more dynamic and malleable ways of viewing mathematics as well as greater cultural competence.

THE CASE OF CULTURAL GWAS ERASURE

The story of the masking of non-European genotypes in modern genomic studies

Written by Kate Hodgson

Throughout history, health professionals have diagnosed patients based on their clinical symptoms and description. In recent years, genome-wide association studies (GWAS) have helped scientists understand the genetic factors involved in various diseases. As a result, researchers are investigating biobank samples from various populations to identify specific genomic loci associated with a wide range of medical indications and traits.

A genome-wide association study (GWAS) is a research technique used to discover genomic variants in the form of single nucleotide polymorphisms (SNPs) associated with the risk of a disease or trait. This technique compares genomes containing the trait to control genomes to determine which variants are significantly more common in those with the trait. GWAS focuses on finding correlation, not causation. This is a major drawback of the results, as they are only as valuable as the number and range of individuals studied. Despite its pitfalls, GWAS has become increasingly popular over the past two decades as a non-candidate gene-driven approach to finding genetic associations with health conditions. This popularity is largely due to the rapidly declining cost of sequencing the human genome throughout the twenty-first century, with the current cost of genotyping an entire genome now less than $50 USD. The first successful GWAS trial was published in 2002, and found associations between genomic variants and cases of heart attacks. With this publication, the popularity of the technique grew as researchers discovered ways of applying GWAS results to the clinical world.

Given that GWAS is a technique that focuses on genomic variants, it is vital to understand how our genomes differ across the planet. The story begins with the original population of Homo sapiens in East Africa. The founder effect is a phenomenon in which there is a loss of genetic diversity caused by a large population arising from a small number of individuals. Alleles in the population are more likely to be lost at a rapid rate due to the increased effect of genetic drift in the small population. This is exactly what occurred when our ancestors first left East Africa. As smaller populations left the original Homo sapiens population in East Africa to populate the rest of the world, heterozygosity (indicating genetic diversity) decreased with distance away from their origin due to the founder effect. Genetic diversity and distance from East Africa have a negative correlation, with Africa having the highest level of genetic diversity, and America (containing the most recent new world population) having the least genetic diversity. Due to the founder effect, humans outside of Africa lack many of the genetic variants found only in African populations.

Considering that researchers have confirmed that populations across the world differ in genomic diversity, it is sensible to think that GWAS studies incorporate diverse genomes within their studies. This is far from the truth. A study by Martin et al. in 2018 revealed that 80% of all participants are white Europeans, despite only contributing 16% of the world's population. Predictions of genomic variants associated with phenotypic traits are not representative of alternate ethnic groups, amplified by the fact that white Europeans have less variation in their genetics. GWAS is used to calculate polygenic risk scores, which measure disease risk due to genetics. The study found that polygenic risk scores were far more accurate in Europeans than non-Europeans. Unfortunately, the diversity of GWAS participants has not been improving, with non-European participation stagnating since late 2014.

The lack of genomic diversity in genome studies has led to the omission of many key variants associated with disease risk. A famous example lies in cystic fibrosis. For many years, it was assumed that the recessive genetic disorder was not present in African populations, as diagnostic kits only searched for genomic variants associated with cystic fibrosis found in Eurocentric populations. Cystic fibrosis exists in African populations, only under the influence of a different variant. To prevent further misdiagnoses and understand the influence of genetics on phenotypic traits, the diversity of GWAS participants must be increased. There are examples of programmes that support sharing genomic data from multiple ancestral origins, such as the All of Us research program, but there needs to be a stronger incentive to expand GWAS participants to non-European origins as the research technique gains traction. Overall, this work provides groundbreaking results addressing relevant predispositions within previous GWAS, and the findings will allow researchers to examine human diseases through genetics with an unbiased eye.

Queering Science Culture: Is science really 'for all'?

Written by Gracie Enticknap

They say we're in an era of 'science for all,' that we're in a time where no one is limited in their access to scientific information, education and career opportunities. Whilst in the past few years, diversity and inclusion programs have gained awareness, importance and increased adoption, I think we still need to ask whether the culture of science itself has adequately adapted to welcome and support this inclusivity. Visibility of LGBTQ+ scientists is gradually improving, but the academic culture within STEM is still experiencing some foot-dragging when it comes to confronting issues of LGBTQ+ inclusion and acceptance in the workplace.

Of course, I should make the disclaimer that there is not just one experience across all queer scientists, and many people might herald that they don't experience these same issues. Some people have unproblematic work lives, much down to their lab colleagues, and that's fantastic. After all, we are seeing increasingly more LGBTQ+ centred media in sciences, such as targeted networking events, inclusion of trans and non-binary people in women and minority gender events, activism projects like 500 Queer Scientists raising online visibility, and LGBTQ+ scientists beginning to be more explicit about their identities on professional socials. These acts for visibility are great, but they aren't happening in tangent to a wider academic culture that is committed to addressing the intrinsic silent issues, so inequalities and disadvantages still frequently exist for queer people in STEM.

We scientists are fortunate to exist in an international and multicultural field which presents us the opportunity for working globally and with people from all over the world. But while that means wonderful things for some types of diversity, it does also present a consequential melting pot of cultural, generational, and personal intolerances, stereotypical epithets, and discomforts towards queer people. People from various cultures and contexts can respond differently to LGBTQ+ individuals, and this opens avenues to workplace tensions, discrimination, bullying or harassment and silent passive aggressions. In fact, research surveys, funded by the U.S. National Science Foundation, in the last half-decade have revealed that non-heterosexual, transgender, and gender nonbinary STEM professionals are far more likely than non-queer colleagues to experience structural barriers like limited career opportunity, hiring and wage discrimination, and other more casual expressions of both overt and subtle biassed treatment by co-workers, peers and supervisors. But when offences and tensions occur, there is often little acknowledgement of them from colleagues who might consider themselves allies, and this is set within a professional culture that rarely encourages the intolerant to learn acceptance. This can create a sense of social isolation or distancing from colleagues and even work friends, but importantly it reinforces an expectation for queer people to censor,

adapt or manage ourselves in order to prevent others' discomfort, and thus perpetuates loud and more quiet bigotries. There's a complex inner negotiation of 'how to be' that most non-LGBTQ+ people don't have to grapple with.

The most significant institutional barrier to overcoming these issues is an apparent depoliticisation in the culture of STEM at the academia level; whereby discussions of social and political issues (like diversity and inclusion perhaps) are often discouraged, side-lined, and bracketed as topics to stay outside the lab and separate from day-to-day work. This excuses the resistance to altering prejudiced attitudes and enables a culture of ignorance around LGBTQ+ sensitive topics for the many who are not prejudiced but simply unaware. This ignorance to the silent issues faced by queer people, malicious or not, exposes the apparent lack of awareness raised and lack of inclusion training provided by scientific institutions for their staff. These days, a lot of institutions are becoming better at training staff in approaching certain types of people and in promoting ideas that normalise diversity such as asking for pronouns, not assigning gender roles in same sex relationships, not making assumptions of gender etc. However, these best practices appear currently reserved to industries that are more customer-facing, like hospitality, law, and perhaps business whereas we scientists are slightly more tucked away in our own spaces only to interact with the public on outreach. So how do we make this cultural shift more effectively trickle through into STEM culture?

The emergence of LGBTQ+ networks in many organisations and academic institutions is a promising way to go, but not without flaws. These networks were originally intended as social groups for LGBTQ+ colleagues to build community – a space where self-management isn't necessary – and to combat the social isolation some may experience by making 'like-minded' friends. But while they may often succeed in encouraging friendships, it can feel incredibly forced, especially when the people within that group will be different ages, from different places, having very different interests. The more recently emergent benefit of these groups, though, is their vitality for raising awareness and fostering conversation about LGBTQ+ inclusion and intersectionality in the context of their specific field of work (and thus lifestyle). This is yet to be fully taken advantage of in many places, as so often, engagement with any message they put out is optional to non-queer people. However, they do typically hold enough collective voice to propose better training and more appropriate responses to misconduct from HR departments.

Implementation of this idea at more institutions, in more effective ways, would hope to see instances of subtle discrimination and judgement decrease, and the visibility of LGBTQ+ scientists increase as STEM develops itself a culture that makes it safer and more encouraging for queer individuals to come out in their workspaces. It's about time queer youth were given more LGBTQ+ role models and mentors, and it's an overdue expectation that we should be able to break into the workplace without needing advice, mentorship or considerate contemplation about how to present and manage ourselves in ways that don't pose an immediate disadvantage. We've come leaps and bounds in the last couple decades for LGBTQ+ acceptance, so we are getting there. Science is and will increasingly be for all.

WARAPOKA

Documenting the biodiversity of an indigenous community

Written by Amaranta Chavez
Art by Amaranta Chavez

Paradise can be found a six hour journey from Georgetown, in northwestern Guyana. Hidden within the rainforest, through the winding canals of the Waini river, the indigenous village of Warapoka is bursting with life. Six hundred indigenous Warau people own and protect 101km2 of land. In this region, you can spot a hundred wild animals before breakfast, which is what a group of researchers and students did in the summer of 2022. I was fortunate to be part of this group.

Warapoka is filled with incredible flora and fauna,including the harpy eagle, red howler monkeys, jaguars and plants with potential applications for western medicine. Unfortunately, much of Guyana's rainforest and its precious biodiversity is threatened by natural resource extraction, such as gold mining. However, the Warau people not only treasure their connection to nature but rely on it, and so are fighting to save it. Until last year, the array of wildlife present in and around the village had not been officially documented. Researchers and teams of students worked with guides from the village to create a species list that could be used to boost ecotourism. By attracting scientific researchers and environmentally conscious travellers, the region can profit off of its natural wonders, rather than practices that would lead to its destruction. Conservation Magazine features an interview with the Tashao (leader) of the village, which explains his vision for the future of Warapoka.

The research that took place was a cultural exchange as much as a scientific exchange. A typical day involved surveys of mammals by tracking footprints or camera trapping. We also surveyed birds and bats using point counts or mist netting; this involved putting up a long, thin net and waiting at short intervals for them to fly into them so that we could carefully extract them and take measurements, such as wing length. Herpetofauna (reptiles and amphibians) were surveyed by observation when out on walks, and butterflies were surveyed using catch and release. In every case, identification was the aim, but more information was taken when possible. Unfortunately statistics cannot do justice to how the guides could spot animals with unimaginable speed and ease, or how one of them, Newton, had perfected the call of the harpy eagle. Our guides taught us so much about the wildlife there, sharing their knowledge of where and when to find animals, with the researchers using identification guides to confirm species names.

Spending time in the community of Warapoka helped us understand how important nature is for their identity and way of life, such as how they use different plants to weave baskets for different purposes and occasions. They have a physically demanding subsistence lifestyle, and the long-standing human snake conflict remains. The presence of many venomous snakes, such as the bushmaster, combined with lack of education of snakes, increases the risk of people killing or being bitten by snakes. Despite this, they live in harmony with the land instead of trying to dominate it. The most pressing threat all indigenous communities face is lack of recognition over their territory and limited right to be involved in political decision-making. This inequality is damaging to them but also to the rest of the world; indigenous communities hold vital ancestral knowledge on how to adapt, mitigate, and reduce climate change and disaster risks.

In the village, we weren't treated like the strangers we were; we were treated like family. I will never forget the leaders of the community standing on the deck, waving us goodbye as we floated down that liquid road one last time. With a smile on their faces, they reminded us to tell our friends about Warapoka, so that is what I am compelled to do.

GAMING THE SYSTEM: How Video Games Could Revolutionise Science Education

Written by Emily Vialls *Art by Shangyu Chen*

Imagine a world where learning about the intricacies of life science is exciting: no more dull lectures, or dry textbooks. Instead, you enter a virtual world where you get to experience the rush of exploration as you uncover the secrets of biology. Welcome to the future of education, where gaming is revolutionising the way we learn about life science. While this may seem unrealistic, perhaps even unachievable, research suggests that virtual games have untapped potential - some of which is already beginning to be tested and harnessed in educational settings.

But how effective are they?

A key goal of science education is training students to be scientifically literate - in simple terms, the ability to understand, experiment, reason, unify concepts with facts, and interpret their meaning. Being scientifically literate equips one to tackle the challenges of an information economy. If used effectively, gaming could be a powerful tool for developing key scientific skills. Such skills can support the underpinning elements of scientific literacy: information processing skills, an understanding of the nature of science, and factual knowledge.

Development of cognitive skills

The nature of gaming promotes engagement. The built-in motivational scaffolds of feedback, rewards and flow states engage learners. Flow states are an optimal state of immersion in an activity, and occur anytime a person is deeply immersed in their task...

... “The ego falls away. Time flies. Every action, movement, and thought follows inevitably from the previous one, like playing jazz. Your whole being is involved, and you’re using your skills to the utmost,” - Mihaly Csikszentmihalyi

But achieving a flow state takes balance; a puzzle too difficult will result in anxiety, whereas one too easy could result in boredom. Games perfectly navigate this issue - by allowing players to adjust the difficulty to fit their skill level. This ensures players can be continually challenged without being overwhelmed.

Maintenance of a flow state results in an enjoyable cognitive experience for the learner. A positive emotional state is necessary for engagement, promoting high levels of sustained attention. Immersion in a task expends less time and energy and thus is more rewarding for the learner than in traditional educational approaches.

Immersion in a game usually involves taking on the identity of others, encouraging players to approach a problem, for example, as a scientist would. In a classroom setting, learners are given problems posed by others, whereas practising scientists define their own goals, within a larger social-historical context. Students are less likely to be engaged by material that does not feel relevant to them, however, video games could provide a new avenue. Players could adopt the identity of a scientist and set their own goals, by learning to develop and test their own hypotheses.

Additionally, metacognition, the ability to evaluate your strengths and weaknesses, is an important component of scientific thinking. Metacognition can be thought of as the difference between knowledge and wisdom and is developed through evaluating actions and outcomes. For instance, scientists may apply this skill in evaluating whether a model or simulation they developed explains a natural phenomenon effectively. In video games, metacognitive thinking may be a requirement for progression. For instance, hitting a ‘game-over’ screen tends to send players back to a previous save point, forcing them to re-evaluate their actions and develop a strategy in order to progress.

Content knowledge

Video games have the potential to explain complicated concepts very concisely. Take, for instance, the ‘Creatures’ franchise - an artificial life simulator. The game focuses on raising alien creatures called ‘Norns’, teaching them to survive, defending against other creatures, and breeding them. The Norns are coded from the genetic level upwards with sophisticated biochemistry and neural network brains.

Creatures encourages players to experiment with the artificial living creatures. They can carry advantageous genes which promote their ability to survive and reproduce. Genes that promote survival can be passed on to

the next generation and promote the survival of their offspring, simulating real genetics. The variation in Norn creation and the environment they survive in is nearly limitless, giving players a wide-ranging evolutionary sandbox to experiment in.

However, educational games like Creatures tend to be an exception, and lack the polish of those in the mainstream. Meanwhile, commercially successful games tend to fall under the umbrella of science fiction, borrowing tropes from books and films. Mainstream media takes a more relaxed approach to science, flexing the natural laws if they conflict with the story being told.

Popular culture assumes that specific genes invariably produce specific traits, ignoring the complexity of gene interactions and the interplay of genes and the environment. For example, in the popular FPS BioShock, genetic engineering is a core aspect of the gameplay. Players can enhance their abilities with 'plasmids' - mutagenic serums which grant the users super-human powers, such as telekinesis and pyrokinesis. Genetic enhancement of characters is a common plot device included in many popular games, such as Final Fantasy, Resident Evil, Overwatch, and Mass Effect, to name a few. The notion that human abilities can be augmented by plugging the right genes into the right places is debatable at best. Yet it is wholly consistent with popular culture's vision of genetic engineering as a technology that borders on magic.

Commercial games are developed, programmed and tested with substantial capital, and consequently, scientific elements are glossed over or deliberately exaggerated to produce a narrative which hooks players. As a result, these games tend to be heavily engaging with low educational benefits. Meanwhile, not-for-profit, serious games are less sophisticated and fail to harness the engaging elements of commercial games. There are few video games which successfully harness both engagement and educational potential.

It is unlikely that the gaming industry will be a reliable source of educational content anytime soon. Commercially, 'educational' titles do not sell well enough to produce a profit. However, not-for-profit educational games could have some potential. As the gaming industry is expanding, cheaper, more accessible tools for developing games are becoming more widely available and will be of benefit to educators. As it stands, 'gaming to learn' is still in its infancy but gaining traction.

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