



THE
KING'S
SCHOOL
—
GRANTHAM



Newton's Cradle

Issue #1
2025-2026

An introduction from our Head Boy

I am incredibly proud to present the first edition of Newton's Cradle.

I started Newton's Cradle to inspire a sharper awareness of the academic debates that surpass the traditional curriculum. There is no doubt that our students regularly produce academic work that stretches far beyond their taught learning, but this work is rarely celebrated as a part of who we are. This publication brings those works together, collating outstanding student commentaries on diverse issues, ranging from biology and physics to politics and philosophy. In turn, it aims to inspire more students to follow their wider academic interests beyond the curriculum and to develop a meaningful passion for learning.

It is also a platform for exchanging ideas. The issues raised by these essays – including quantum technology, the legacy of empire, and political strife – are enormously relevant in our current lives. They shape the world that we will soon inherit and govern. It is therefore vital that we, as young people, have the intellectual dexterity to address these issues with confidence. We mustn't shy away from debate and discussion, and Newton's Cradle provides a platform for exactly that.

I am delighted that several of our featured essays have received coveted awards in national competitions, including from Oxford and Cambridge. That is a testament to the aspiration sitting at the heart of the school's ethos, but it also serves as a reminder of what all King's students can achieve – I hope students across both Sixth Form and Lower School will read these essays as a model of what they can accomplish by discovering what boys like them have done before.

The spirit of creativity and independent-mindedness behind each of these essays relates to the publication itself, too. It is now yours to shape – your research, writing, and commentary will feature in subsequent editions. You will raise the issues and discussions that you believe matter most. In that spirit, I hope that future year groups carry this legacy forward and bring its opportunities to many more students.

My thanks to every student who submitted their work, the editorial team who have brought the pieces together, and to Mr Pickett and Mrs McKenna for their kind contributions towards the publication.

I sincerely hope you enjoy reading the collection,

Oli Calder

Head Boy



From the Editors

Dear Reader,



elcome to the first edition of the King's School Grantham's own academic journal: Newton's Cradle. 'Principia', the landmark work of Isaac Newton, our great alumnus, granted the form of words to the abstraction of idea. Our knowledge is built from foundational writings in all areas, this human inheritance allows words on a page written by man to provide meaning to the universe. This distillation of fragment to material form is the chiefest skill a student can have. Currently the world lacks the vital communication skills necessary in the realms of science, the arts, philosophy and politics and it is imperative that this deficit be resolved so that the knowledge of humanity becomes accessible to all. Writings are in retreat from the realm of public consciousness, literacy as the conduit of ingenuity has begun to erode, to be replaced by the immediate, the comfortable preconception. Nowhere is this more true than in the realm of the sciences, where the barrier to entry renders understanding increasingly difficult. Newton's Cradle contains the natural subjects for the essay format: politics, theology and history, but we have sought to bring more light to the sciences and their presence in essay form, as the study of the interior world of humanity must be blended with the study of the exterior world of nature. It is only when these two studies are both examined and disseminated in equal regard that we have begun to address the crisis of literacy. This is not to pretend that Newton's Cradle can resolve these problems, but to suggest that any step towards the democratisation of knowledge is essential, and that this democratisation must be paired with the education and provision of skills to access this knowledge in its most essential form. The goal of this journal now, and hopefully into the future, is to grow this democratisation and education within the environment of the King's School. It is our hope that Newton's Cradle can be a rung on the ascending ladder to the 'shoulders of giants' from which mankind may survey the domain of his knowledge.

King's is a school which has produced and continues to produce talented pupils capable of thoughtful writing; several of the students whose essays are enclosed have gone on to win prizes in national essay competitions. However, so far these students have had no public outlet through which their writings can be shared. Students, school and society can only benefit from allowing those pupils to hone their craft and share it more broadly. In researching, writing and editing for the essays enclosed, the students represented have pushed themselves beyond the curriculum, an effort which will not only serve them as students and later members of wider society, but which will round them as people. It took exceptional work and skill for the students included in this edition to put together these essays. These students ought to be immensely proud of their work and their essays provide valuable insights into their topics and teach the reader as much as the writer. It is clear to us that taking the time to read one of these essays will leave one with a richer understanding of the world.

This journal would not have been possible without the contributions of the students, those who took the time to come to terms with a topic to such a degree that they could write about it, and produced exceptional pieces of writing. To them this project is indebted, and this first edition dedicated.

It is our hope that this project may become a tradition of the King's School, to serve as the outlet for students for years to come. This is only the first edition, and so we begin with the message: To many more.

Yours Sincerely,

The Editorial Team of Newton's Cradle.



Are generalist species that look like specialists (Liem's paradox) evolutionary mistakes?

ZIKIU HO

L*iem's paradox was first proposed by Karel F. Liem in 1980, where it was noted that certain species, in particular African cichlids, possessed specialised morphological structures that enabled them an advantage when feeding on certain foods, and yet they often had more generalistic feeding behaviours. It was then further shown by multiple studies that this nature was exhibited by various other animals, most notably finches and elephants. This essay will therefore start by examining the morphology of several of such apparent generalists, before then considering their possible evolutionary heritages and potential benefits to the organisms in question, and finally debate whether these examples should be considered 'evolutionary mistakes'.*

One solution to Liem's paradox can be given by the Robinson and Wilson model, based on the optimal foraging theory, which suggests that animals forage by attempting to maximise the energy obtained per unit of time spent. It follows that, when resources are abundant, animals should prioritise resources with a high energy return per time investment. Since there exists resources that are intrinsically easy to obtain for all animals, during these times most animals would act as 'generalists' and compete with each other for these same high value resources. Using Liem's object of study in his paper that proposed

this paradox as an example, cichlids are highly adapted to feeding on molluscs and other shelled prey; however, they are often found to consume algae, zooplankton, and other aquatic insects, acting as 'generalists' because these foods are the easiest to access. On the other hand, as resources become more scarce, such as during the winter, animals are forced to consider resources that are lower down on their priority lists, and they may have to prey on foods with a lower energy return per time investment. It then follows that, during these periods, it becomes beneficial to have morphology

with specialised features, as it allows animals to become 'specialists' and heavily cut down on their energy cost while maintaining a relatively high energy profit to time ratio. Continuing with the example of cichlids, their pharyngeal jaws become significantly more impactful as they start to hunt for snails and similar shelled foods that are more difficult to obtain. In this way, cichlids act as generalists during periods of high food abundance, and their adaptations and specialisations bring them little to no detriments; simultaneously, during times of scarcity,

"Elephants have teeth that seem to be adapted to eating grass, but they don't usually eat grass."

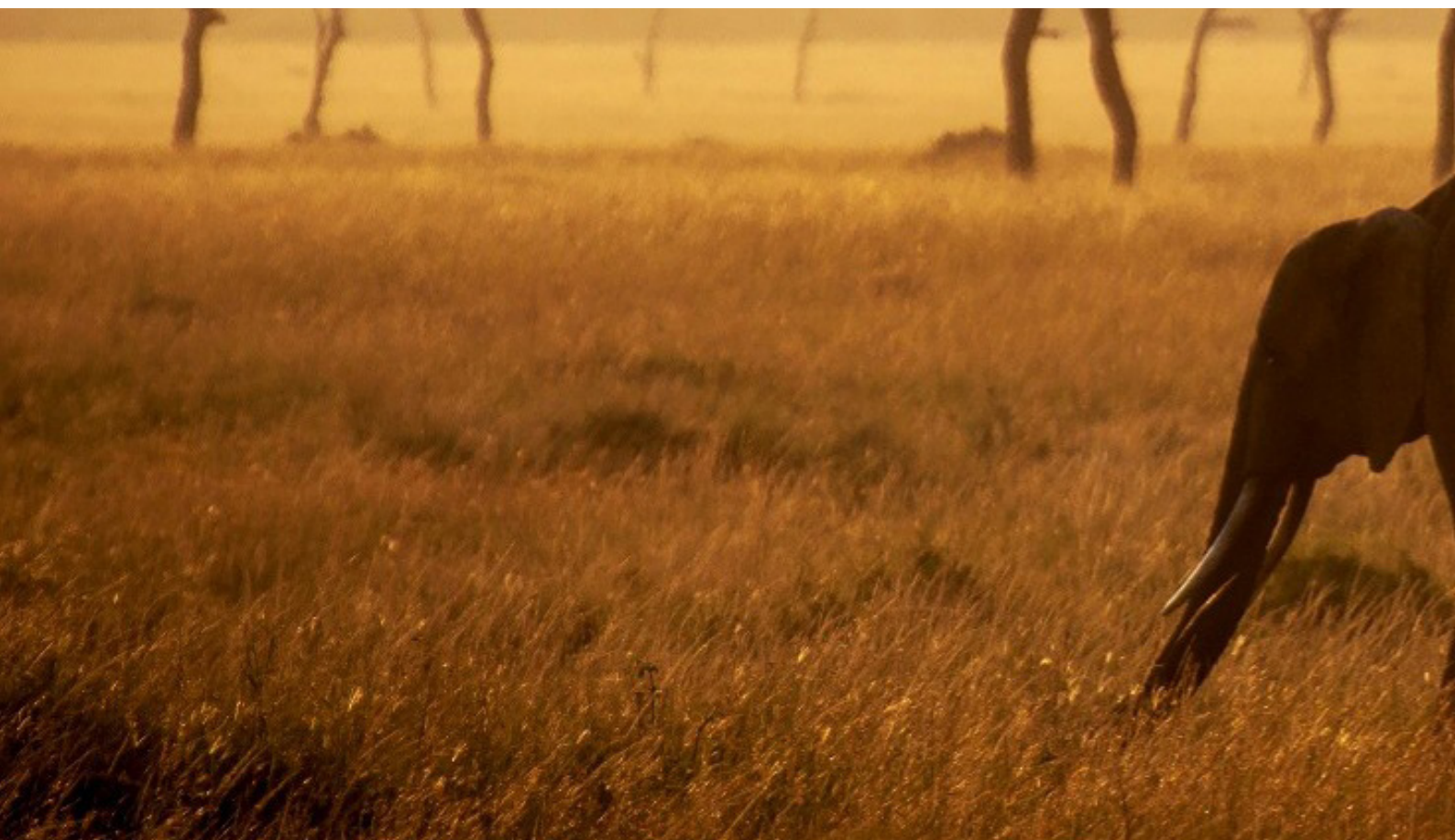
those adaptations rise to importance and allows cichlids to then act as a specialist and grants them a competitive edge. In this way, their specialization is perhaps more of an adaptability, allowing them to alter their diets in response to changes in resource abundances during different time periods.

This model is then further enhanced by a later study which emphasises on the importance of 'fallback foods': species of finches act as generalists despite their beak adaptations; however, their adaptations give them access

to certain fallback foods that are beneficial in periods of scarcity. Specifically, in 1977, a drought resulted in a significant decline in the abundance of small seeds on Daphne Major, an island in Galapagos visited by Darwin. This sudden change meant that finches with larger beaks were more adapted to survive as they were able to open the large seeds that still remained, showing the importance of having a morphology with specialist features despite usually behaving as a generalist such that a 'private' resource is still retained¹⁰. Furthermore, morphology relates to behaviour in more ways than just feeding. For finches, beak shape has various other functionalities, including preening, vocalization, and nest construction. This highlights that, even if an animal appears as a generalist, there often continues to exist benefits to having specialised morphological features.

In a similar vein, elephants having access to teeth that apparently specialise in grasses can be beneficial as a fallback strategy during scarcity. Various Mammalia, including Proboscideans, saw a dietary shift around 10 to 8 million years ago towards grazing during the grassland expansions in the late Miocene

A higher mean mesowear angle corresponds to a higher proportion of grasses in the diet, suggesting a 'grazer' feeding strategy; a lower mean mesowear, therefore, corresponds to the 'browser' strategy. It can be seen that modern Elephantidae (represented by green symbols) have on average a higher mean mesowear angle than ancient proboscidea, suggesting an evolutionary shift towards feeding on grasses, which corresponds to the



earlier mentioned grassland expansions starting 10 to 8 million years ago.

However, despite this, the mean mesowear angle of proboscideans peaked at around 2 million years ago, and have since been declining; this is supported by another study that also concluded a recent return of diet towards mixed feeders. Therefore, one reason elephants seemingly exemplifies Liem's paradox is perhaps because they first evolved specialist features during the late Miocene to feed on C4 grasses, but then as they became outcompeted they shifted back to being mixed feeders. This is supported by various studies that show behavioural flexibility evolved independent of morphology, suggesting behavioural adaptations are able to evolve in a shorter time frame. Furthermore, diet compositions show constant seasonal variation as different resources become available. In this way, perhaps the generalisation elephants seem to exhibit are in truth a behavioural adaptation for better odds of survival.

IS LIEM'S PARADOX AN 'EVOLUTIONARY MISTAKE'?

Having considered Liem's paradox in several groups of animals, namely Cichlidae,

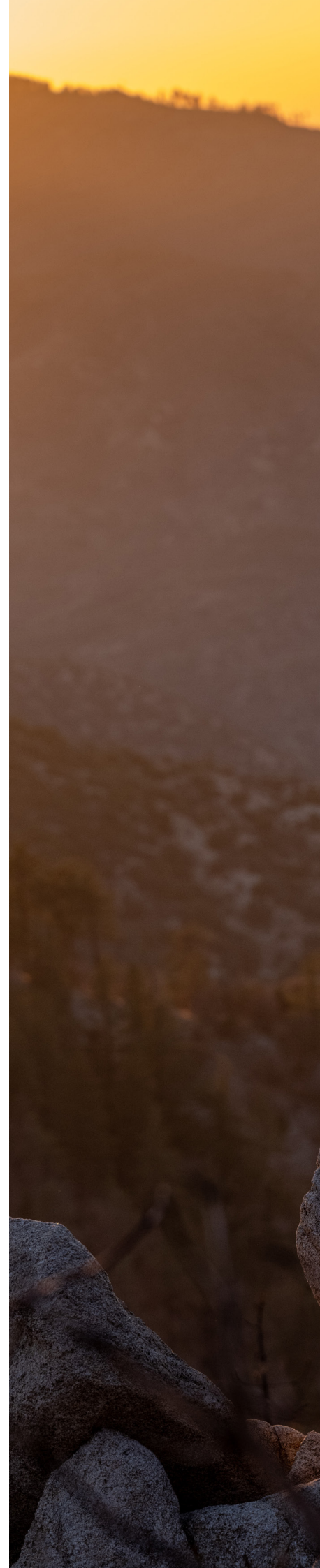
Passeriformes, and Proboscidea, we now return to the question of whether this is an 'evolutionary mistake'. In Darwin's theory of natural selection, animals are born with traits (i.e. phenotypes) that may grant them an advantage or disadvantage, and those with beneficial adaptations are more likely to survive, breed, and produce offspring to pass on their genes. In this way, selection is not driven by a goal to 'produce the best animals'; instead, it simply works towards 'good enough for now'. Selection only drives these 'survival machines', as Dawkins puts it, towards replicating and passing on their genes; for instance, male *Dolomedes tenebrosus* are cannibalized by females after copulation, but this gene is able to propagate itself through the gene pool because it benefits the female and the offspring produced, giving them plenty of nutrients through sacrificing the male. Furthermore, selection occurs on the basis of random, spontaneous gene mutations which cannot be controlled. Therefore, while it may appear that it is an error in nature that certain animals act as generalists despite carrying specialist features, these behaviours evolved as a result of many generations of random changes in the background environment. Selection ultimately lacks a 'designer', and it follows that it is unable to truly make 'mistakes'. ■



The True Cost of Friendship

EMMANUEL MUOKA

Recently, I wondered, "How much effort should I put into this friendship?" Initially, it seems simple right? 'As much as I can.' There does not seem to be a reason why I would not invest in something like a friendship. However, if I were to consider my effort as a limited resource, basic economic principles might allow for a different viewpoint. Rather than unconditionally giving 100%, I might decide to invest only as much effort as the other person contributes or however much effort provides me the greatest utility. But that is the issue, how can I quantify something as abstract as emotional effort? It cannot accurately be represented by numbers on a spreadsheet or lines on a graph. Yet, despite its intangibility, the decision remains crucial and ever-present. Regardless of whether I can measure them accurately, effort and attention are scarce resources and should be treated as such, especially given the countless ways I can allocate them in my life. This suggests that economic theory, particularly concepts such as opportunity cost and cost-benefit analysis, can help me frame decisions about emotional investment in relationships in the future.







Whenever deciding, it is important to consider the opportunity cost of the option chosen. In the context of deciding how much effort to invest in a new friendship, the same basic principle applies. However, as previously mentioned, the consequences of each choice may not be as easily compared as, say, fiscal policy or subsidies. Even so, considering the marginal opportunity cost of investing time, money, and energy into a friendship could have helped me make a more informed decision.

To break this down, I would evaluate my effort in terms of time, money, and energy. Effort is a scarce resource, and by spending it on a friendship, I am inevitably allocating less of it to other areas. A study at Bedford Sixth Form found that over 77% of students are failing to meet the BBC's recommended 9-10 hours of sleep. This indicates a misallocation of time, due to the lack of understanding around merit goods like sleep. This is important because it speaks to how time, as a scarce resource, plays a key role in how much effort I should invest in a friendship. The economic theory here is helpful—it underscores the trade-offs in our decision-making.

Similarly, I often overlook the financial aspect when considering how much effort to invest in friendships. A 2021 survey revealed that 76% of university students have considered dropping out due to financial pressures. Yet, the social expectation is that university is the ideal time to build friendships, regardless of the financial strain it may cause. This is not to suggest that I should not make friends or that money is required to build meaningful relationships. However, an economic analysis of these investments helps me appreciate the trade-offs involved in such decisions.

It is also crucial to consider the energy required in a relationship, ensuring that the effort is sustainable to avoid burnout, while also not detracting from other

important activities like revision or exercise. These activities contribute to long-term and short-term utility, which is good for my personal development. However, my decision to invest in friendships does not necessarily exclude me from other activities, as I can combine social time with productive tasks, such as revising or exercising with friends—provided the right people are involved. The type of friend I engage with plays a key role in determining the marginal opportunity cost of investing in a relationship, highlighting how the situation impacts decision-making.

While it is important to consider the tangible costs, the intangible benefits of friendships should not be overlooked. Emotional and personal growth from these relationships can sometimes outweigh the immediate costs. The concept of marginal utility is relevant here: how much additional value does one more hour spent with a friend bring? Eventually, additional effort may lead to diminishing returns. This is evidenced in the article by the Oxford Press whose findings suggest that the effect of social interaction frequency on well-being is subject to diminishing returns. Therefore, it is necessary to balance emotional and social needs with the practical costs to make well-informed decisions, another key part of economic decision-making.

When considering any action from an economic viewpoint, it is natural to try to maximise utility. This same principle can be applied to investments in friendship. One way to approach this is through game theory. In the context of game theory, friendships can be likened to the Prisoner Dilemma, where both individuals (assuming a closed two-person system) must choose to either cooperate (fully invest in the relationship) or defect (withhold effort). The challenge lies in the ambiguity of the other person's choice. If both cooperate, the relationship thrives, and both benefit. If one defects, however, the emotional

investment becomes unsustainable for one party, leading to dissatisfaction or resentment. If both defect, the relationship fails. This suggests that investing effort is the best strategy to ensure a thriving relationship.

While game theory provides an interesting and theoretically rewarding way to understand relationships, it can seem overly calculated, detaching from the organic and irrational nature of friendships. This brings up a broader counterargument: while economic theory can allow for more efficient and productive decision-making, over-analysing relationships can lead to a rigid approach, potentially undermining what makes friendships meaningful.

After reflecting on economic principles, it has become clear to me that ideas such as opportunity cost and even game theory can be useful for making more intentional decisions. By seeing time, energy, and money as scarce resources I can be more intentional about how I allocate them. I do believe however that it is essential to remember that such branches of thought are only frameworks and that without careful situation application they can do more harm than good. All this said, if I understand not all decisions are as simple as drawing lines on a graph but also that no choice is without trade-offs, I can use economic theories to help me make decisions in the future. ■

“ Effort is a scarce resource, and by spending it on a friendship, I am inevitably allocating less of it to other areas.



How does economics help to explain the high price of a supercar?

EMMANUEL, RAVISH, EDWARD AND
LARS (COLLABORATIVE ESSAY)



S*upercars, also known as exotic or performance cars, are street-legal vehicles with power, speed, and handling capabilities only paralleled by that of top-level motorsport prototypes. Interestingly, these luxury vehicles seemingly break many of the confines of conventional economic theory and challenge the typical models associated with microeconomic behaviour.*

For instance, supercars are unique from a conventional economic standpoint as they have close to perfectly inelastic demand due to the target market segment being of such an affluent nature that they have a very minimal marginal utility of money (Mankiw, 2020). Supercars portray the rare case of a Veblen good, as the psychological influence price has on the perceived quality and reputation of the product means that an increase in price increases the quantity demanded, as the standard is perceived to be greater (Veblen, 1899; Bagwell and Bernheim, 1996). As per conventional economic theory, an increase in price reduces the number of consumers who are willing and able to purchase a good or service. Hence, this would act to improve the social prestige of supercars, as these goods become less feasible purchases for consumers with reduced purchasing capabilities. This, in turn, increases their exclusivity, which serves as a derivation of their demand.

Instead of price, the biggest factor influencing demand is public perception, as supercars are status-sensitive assets (Frank, 2007). Hence, it is arguably more suitable to compare supercars to that of designer goods than that of ordinary cars, as they act as speculative luxury assets. Their ordinary function as a method of transportation is less desired compared to their role in elevating prestige and possibly acting as an investment with the potential for appreciation over time (Kapferer and Bastien, 2012). Some consumers perceive the initial monetary burden of supercars as insignificant when considering the prospect of such being an appreciating asset. These factors help justify seemingly astronomical prices, as firms who act as profit maximisers can raise prices while maintaining demand, since the market appetite is driven by social factors rather than monetary utility (Becker and Murphy, 2000). Thus, in the interim, supercars operate beyond the traditional concepts of supply and demand, as their demand stems from psychological benefits rather than conventional utility.

Another contributing factor to the high cost of supercars is the lack of economies of scale and the nature of the oligopolistic market structure in which they operate (Sloman, Garratt and Guest,

2018). Unlike mass-market car manufacturers who function in a highly competitive, high-volume market, supercar manufacturers such as Ferrari, Bugatti or McLaren do not have the luxury of producing millions of units or reusing standardised parts to reduce production costs. Because makers produce at low volumes and customise cars to the buyer's unique specifications, manufacturers essentially design bespoke vehicles, which increases unit cost significantly. The labour-intensive nature of the production process adds to this, with labour costs accounting for approximately 15–25% of the production costs (Statista, 2023). The supply of highly skilled mechanical engineers is relatively scarce, and this scarcity is rationed through market wages, which are often high due to limited supply (OECD, 2020).

Research and Development (R&D) costs are also a significant factor in pricing. Supercar manufacturers spend vast sums on pushing the technological limits of speed, aerodynamics, and acceleration, often disregarding mainstream car selling points like fuel efficiency or safety (Hoffman and Coste-Manière, 2012). These costs are passed on to the consumer, who is often willing to pay for what they perceive as a fair trade-off for prestige and performance.

To conclude, supercars exist with functionality seemingly indifferent to that of a regular vehicle, and comfort is rarely prioritised by performance-focused manufacturers. The main stimulant of high prices is not the physical product itself, but the prestige facilitated through ownership. Supercars reflect patterns observed in ultra-luxury goods: price is not a focus of competition; instead, brand identity and exclusivity dominate market success (Kapferer, 2015). Barriers to entry in this industry are not just financial but symbolic, with success driven by heritage and brand power. Critically, supercars are demanded precisely because they are inaccessible to the masses, their exclusivity itself fuels demand ■

What is Quantum Computing?

HARIHARAN BALAMURUGA

Quantum computing represents a revolutionary shift in information processing, utilising the principles of quantum mechanics to perform computations that lie far beyond the capabilities of classical computers. As research in this field progresses, it becomes increasingly important to understand the potential applications of quantum computing.

QUANTUM SUPERPOSITION

Superposition is a fundamental concept in quantum mechanics, describing how a quantum system can exist in multiple states simultaneously. Unlike classical bits, which are either 0 or 1, a quantum bit, or qubit, can exist in a superposition of both. The general state of a qubit can be written as:

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$

where α and β are complex numbers, whose squared magnitudes represent the probabilities of measuring the qubit in state 0 or 1.

Here, the probability of seeing $|0\rangle$ is $|\alpha|^2$ and the probability of seeing $|1\rangle$ is $|\beta|^2$.

This uncertain, mixed state persists until the qubit is observed, at which point the superposition collapses into a definite outcome.

Superposition is what gives quantum computing its exceptional potential. A classical computer

processes one state at a time, whereas a quantum computer with n qubits can represent all 2^n possible combinations of bits at once. For example, a 3-qubit system holds all 8 possible states simultaneously, and a 50-qubit system can encode over a trillion. This capability enables quantum processors to explore a vast number of computational paths in parallel. While measurement reveals only a single result, quantum algorithms such as Shor's (for factoring) and Grover's (for search) are designed to amplify the correct answers by manipulating the superposed states, making superposition essential for quantum speedup.

QUANTUM ENTANGLEMENT

Entanglement is a quantum phenomenon in which qubits become correlated such that the state of one depends on the state of another. For example, if one qubit is measured as 0, the other will also be 0; if one is 1, so is the other. This kind of correlation defies classical understanding and underpins many quantum technologies.



Entanglement is a vital computational resource. In quantum algorithms, entangled qubits evaluate multiple interconnected possibilities simultaneously. Entanglement is also essential for quantum error correction, which protects quantum data without directly measuring it. Additionally, entanglement underlies quantum communication techniques such as quantum teleportation and superdense coding, offering capabilities impossible with classical systems.

QUANTUM GATES AND THE CREATION OF ENTANGLEMENT

Quantum gates perform operations on qubits and are the building blocks of quantum circuits. Certain gates, like the Hadamard and Controlled-NOT (CNOT), are specifically designed to generate entanglement. The Hadamard gate

not classical probabilities, allowing them to interfere. Depending on their relative phases, these amplitudes can reinforce (constructive interference) or cancel each other out (destructive interference). This behaviour is exemplified by the double-slit experiment, where individual particles produce an interference pattern over time. The core idea is that the probability of an outcome arises from the interference of multiple paths' amplitudes.

In quantum computing, interference is exploited to guide the system toward correct outcomes. Quantum algorithms are designed to manipulate the phases of different computational paths so that incorrect results cancel out and correct ones are amplified. For instance, Grover's algorithm boosts the probability of finding the correct item in a database, while Shor's algorithm uses interference to identify hidden periodicities. This precise control of interference enables quantum

"Entanglement is a vital computational resource"

creates a superposition, and when followed by a CNOT gate, it produces an entangled pair. The universal gate set is sufficient to implement any quantum algorithm, including those that require entangled states.

SCALING WITH ENTANGLED QUBITS

The power of quantum computing scales exponentially with the number of entangled qubits. An n -qubit entangled system represents correlations over 2^n configurations, a level of complexity unmanageable for classical simulations when n becomes large. Thus, entanglement enables quantum computers to handle exponentially more information using fewer physical resources.

QUANTUM INTERFERENCE

Quantum interference results from the wave-like nature of quantum systems. Quantum states combine as complex amplitudes,

algorithms to outperform classical counterparts in specific tasks.

APPLICATIONS OF QUANTUM COMPUTING

Cryptography: Quantum algorithms can break widely used public-key systems, driving a transition to post-quantum cryptography. Meanwhile, quantum protocols like quantum key distribution (QKD) offer provably secure communication.

Materials Science and Chemistry: Quantum computers can simulate molecular and material systems more efficiently than classical computers, aiding drug discovery and materials design. Algorithms like the Variational Quantum Eigensolver (VQE) are used on current devices to estimate molecular energies.

Optimisation: Many real-world problems in logistics, finance, and machine learning are optimisation problems. Quantum algorithms

$$H(t) | \psi(t) \rangle = i\hbar \frac{d}{dt} | \psi(t) \rangle$$

such as QAOA or quantum annealing may provide faster solutions for specific instances.

Machine Learning: Quantum-enhanced machine learning explores the use of quantum computers to accelerate linear algebra subroutines or implement quantum neural networks. Though early-stage, this is a growing area of interest.

Scientific Computing: Quantum simulations could transform fields like high-energy physics, climate modelling, and finance, where classical simulations are limited by complexity.

Trapped-ion and neutral-atom platforms, while coherent, require highly stable lasers. Additional issues include manufacturing yield, calibration, and inter-qubit connectivity.

Progress and the Path Forward

Despite challenges, steady progress is being made. Advances in hardware design, control systems, and quantum error correction are gradually improving performance. Google's demonstration of a distance-7 surface code with a logical error-per-cycle of ~0.14% is a promising sign. However, achieving fault-tolerant quantum computing at scale will demand significant further innovation and effort.

CHALLENGES IN BUILDING QUANTUM COMPUTERS

Developing large, practical quantum computers remains difficult due to the fragile nature of qubits and engineering complexity. Qubits lose coherence easily, are sensitive to noise, and require precise control. As circuits become deeper, errors accumulate, limiting the length of reliable computation.

QUANTUM ERROR CORRECTION AND FAULT TOLERANCE

Quantum error correction encodes a logical qubit into many physical ones to protect against noise. For instance, Google's 101-qubit Willow chip used surface-code error correction to reduce logical error rates below physical ones, a milestone known as "below threshold." However, reaching this regime requires low base error rates and introduces high overhead: thousands of physical qubits may be needed to create just a few logical ones.

Engineering and Scalability Limitations

Scaling up quantum systems introduces serious engineering hurdles. Superconducting qubits need complex cryogenic wiring and dilution refrigeration at millikelvin temperatures.

THE PROMISE OF QUANTUM COMPUTING

Quantum computing holds the promise of solving certain problems far more efficiently than classical supercomputers. Shor's algorithm, for example, can factor large numbers exponentially faster than the best-known classical methods, posing a threat to current encryption systems. Grover's algorithm offers a quadratic speedup for unstructured search problems. While today's quantum devices are small and noisy, the potential impact on fields like cryptography, optimisation, and drug discovery is profound, with market forecasts predicting major commercial applications by the 2030s.

CONCLUSION

Quantum computing has progressed from a theoretical idea to experimental systems with limited capabilities. Its future impact depends on overcoming significant challenges in scaling and error correction. Nonetheless, recent advances and strategic investment suggest quantum computers may soon play a transformative role in science, industry, and national security. ■

A Limited Imagination

JAMES DIAMOND

Across the world, low economic growth, support and productivity have led to a rise in support for the politically unorthodox, both left and right. Mere economic inequality fails to explain the gain of Right over Left. So, it seems that some crucial distinction in rhetoric (that which they blame for economic failings) must be a cause—a reason why the narrative of class conflict is superseded by a narrative of cultural conflict. Here, it seems that the divide is one of empathy and relation to others: the ability to empathise and associate with the group deemed 'responsible' for economic failings by the populists of both left and right.

For the 'Populist Right', the group often held accountable for economic failings are immigrants, as discussed at the beginning of this essay. However, there must be a reason why a narrative of immigration is more effective than a narrative of class, and for this it seems necessary to look at community. In his work 'Imagined Communities', Benedict Arnold offers a conception of the nation under the same name. Nations are 'imagined political communities'. These communities are 'imagined' in the fact that it would be impossible to be acquainted with each member, yet they are 'communities', as they contain a 'deep, horizontal comradeship', this comradeship is importantly argued to exist regardless of inequality within the community. Through this framework, the rise of the 'Populist Right' can be explored as a product of the empathy of community, and the ease by which one can be protected by membership of the community and excluded in lacking membership.

The lack of empathy for migrants is clear, an August 2020 YouGov poll found that 22% of respondents had 'Not much sympathy' for those crossing the channel, and a further 27% had 'No sympathy at all'. This has theoretical basis in the work of Benedict Anderson, as he argues that the 'Imagined Communities' are impeded by the fact that they are 'inherently limited': no national identity can encompass all of humanity. Thus, there is a necessity that an insider-outsider dichotomy, such as that purported by the 'Populist Right', comes into existence.

By virtue of the reliance of the existence of a nation on a community which perpetuates comradeship and relatability coupled with the fact that there is an impossibility for this community to fully encompass all of humankind forces certain members of humanity to be excluded. In an increasingly globalised world, for someone who is deemed 'excludable' by difference in religion, ethnicity or culture, the

chance of immigrating to a country for which they are 'excludable' is ever growing. For those making crossings on small boats, from 2018 to 2024, 18.5% were from Iran, 14.7% were from Afghanistan, and 13.2% were from Iraq. These are nations with majority Muslim populations, for which the ranking on the EF English Proficiency index ranged from 'Low' to 'Very Low Proficiency' in 2024. It seems clear that the naturally limited reaches of an 'Imagined Community' necessarily fall short in incorporating immigrants from such backgrounds as there is a natural inability to 'imagine' someone of such a different culture as a member of one's 'community', and this when coupled with the exclusionary nature of the community ultimately limits integration. Here it seems clear that the 'Populist Right' is able to utilise such a divide intrinsic to the nature of nationality to present a system of blame not bounded by empathy for the recipient immigrant, since this recipient necessarily lies external to the national 'community'.

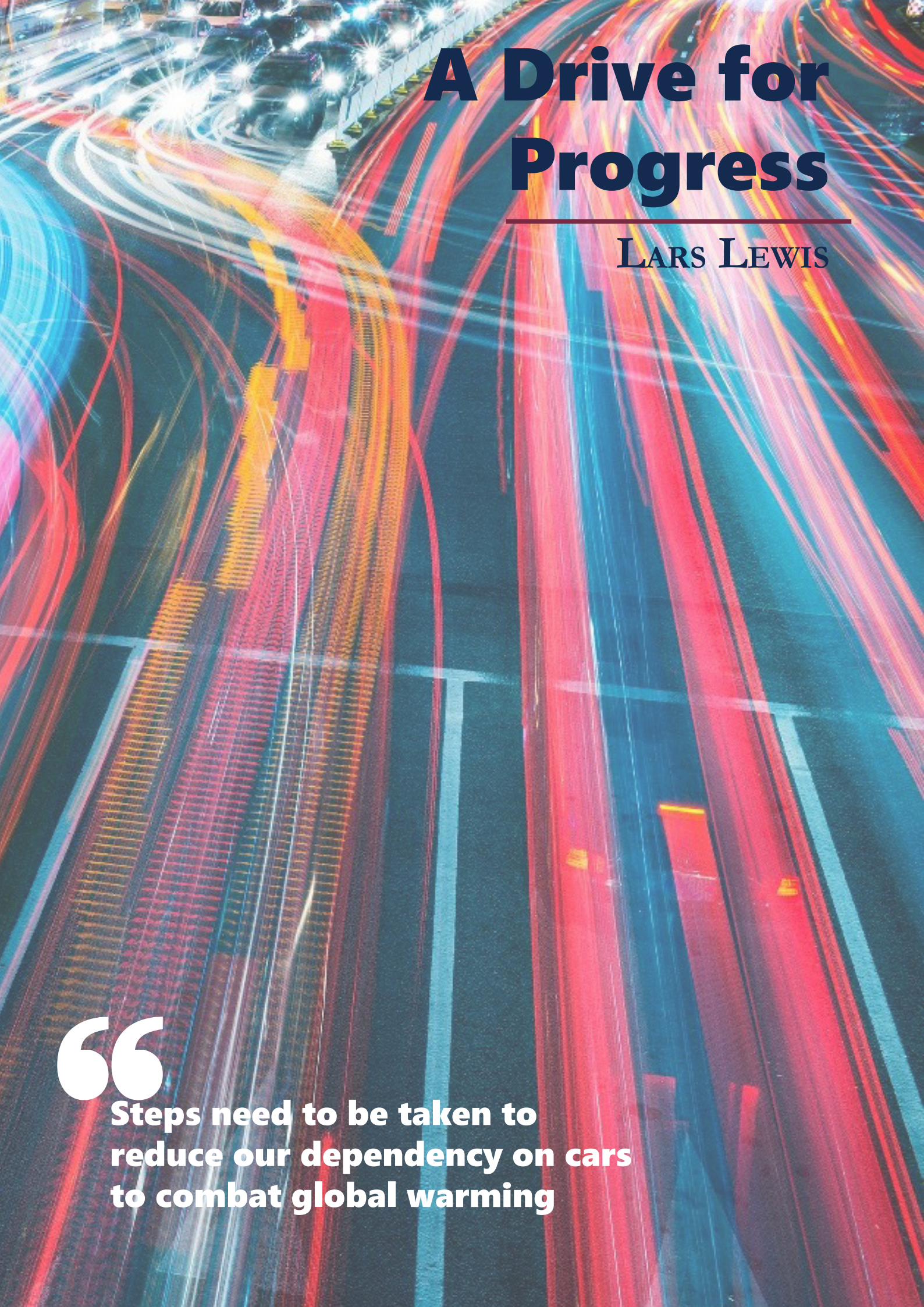
This explanation rooted in conceptions of community could aid in understanding the reason why class conflict is not afforded the same level of credence by the modern population when choosing political parties, and as such, the 'Populist Right' overtakes the 'Populist Left'. With capitalism comes the notion of 'meritocracy'; the idea that one deserves the wealth that they have gained. There is a pervasive belief that through 'hard work', one can become wealthier, and that 'hard work' and 'ambition' are the two most important factors in becoming wealthy, this can then be taken with the fact that within a given country, the wealthiest individuals and importantly those best known for their wealth are those who were born and raised within the country, and vitally, within a culture not dissimilar to that of the given country. So here an image cultivates of the 'home-grown', a wealthy individual associated with the country of their birth: Richard Branson, James Dyson, Bill Gates, and Mark Zuckerberg. Yet even those who are wealthy and yet known outside of their

country share key 'community' characteristics with the countries in which they reside. Elon Musk, currently a US citizen, was born in South Africa, spending 17 years of his life there. Here, despite the de jure national difference, South Africa bears several similarities in the features of 'community' with the United States: a majority Christian country, where English is a commonly spoken language as by Musk, with the additional but necessary caveat that Musk is white. As such, to the majority of Americans, Elon Musk matches in important features of the American 'Imagined Community'.

Here, the divide becomes clear between the chose figures of blame for the 'Populist Right' and 'Populist Left'. The important nature of the 'Imagined Community' maintaining a 'deep, horizontal comradeship', the image of the wealthy as meritocrats who achieved their positions through hard work, and the ease with which the most well-known figures of wealth can be placed into an 'Imagined Community', create a perception in which it is easier to empathise with the position of the wealthy individual, and significantly easier to accept the marginalisation of someone for whom there is little cultural overlap.

As such, the 'Populist Right' can galvanise a national community against those who can more easily be perceived as outsiders for their non-conformity to the limited 'Imagined Community', contrasting the 'Populist Left', where the blame is placed at the feet of those commonly perceived to be deserving of their position, and importantly, integrated into the 'community' of the population. This is the source of acceptance of the narrative of the 'Populist Right', it coalesces with the consensus of the majority group of a given nation, allowing for the pervasive continuation of the 'Imagined Community' vital in the collective consciousness of a state. ■

"The nature of nationality presents a system of blame not bounded by empathy"



A Drive for Progress

LARS LEWIS

“

**Steps need to be taken to
reduce our dependency on cars
to combat global warming**

Cars are often hailed as the most reliable and necessary method of transportation due to their accessibility and speed; however, the use of them causes many negative externalities, especially emissions being released. When compared to its alternatives such as trains or even walking (which release far less emissions if not none), households need to reduce their dependency on cars to help climate initiatives. It should be noted that electric cars are being innovated and are becoming cheaper, which tackles climate change as they do not release emissions. This brings into question whether dependency on cars even needs to change as electric vehicles have the opportunity to entirely replace diesel and petrol cars. Although they still release a large amount of emissions during production, and they are still too expensive to be viable for all income groups and can sometimes be less convenient than petrol or diesel cars. Steps need to be taken to reduce our dependency on cars to combat global warming. The main way to tackle this issue is to promote alternative methods of transport, or to reduce the overall need for transport within the UK.

As of 2024, approximately 85% of the UK live in Urban Areas, this means strategies targeting urban areas would have amplified effects, and it is arguably easier to reduce dependency on cars in urban areas. One-way households can become less reliant upon cars is through strategic urban planning. Urbanisation utilises agglomeration to have almost everything households need within 1 place. Alongside its economic efficiencies, mixed-use urban planning strategies can integrate residential, commercial, and recreational spaces all within close proximity. This makes walking or cycling a more viable substitute for cars as locations are more accessible via these methods of transportation.

Furthermore, cities are often designed around pedestrian use due to multiple benefits such as more social interactions, being more environmentally sustainable, improved safety, as well as being a more efficient way of accommodating a high population, as pedestrians take up less space than they do in cars. Therefore, pedestrians are often prioritised in city planning, through traffic calming measures such as walkways, lower speed limits, frequent traffic lights, and speed bumps. This makes cars an even less viable option, as their previous advantage of being quicker is eroded away in cities.

The high population density of urban areas also means that there would be lots of traffic and congestion, further slowing down cars, and making them less viable. It's also important to note the potential failures this might have on the environment, as if people continue to use cars for other reasons, journeys are longer due to traffic, and the emissions released per journey would subsequently be larger.

Other planning restrictions discourage the use of cars, for instance, the shortage of car parks within major cities due to large populations and a lack of land discourages the use of cars, as people would either be unable to park, or have to pay

a high price due to the low supply and high demand of car parks, further disincentivising them.

Meanwhile, law and regulation within cities is often used to disincentive car usage. This can be through congestion charges, whereby charges are imposed on people using cars in busy areas at busy times. This can be seen as to drive in certain areas of London during peak hours, there is a £15 per day charge. This policy was relatively successful, reducing traffic by 15% and congestion by 30%, as well as generating £282 million in revenue in 2019-2020. Similarly, low emission zones and clean air zones are used to disincentivize the use of cars in certain places, as road users either must pay a fine or are banned if they don't meet emission standards. Financial barriers such as these can convince people to use other methods of transportation by making them more financially viable; however, it is important to consider potential inequity issues because of this, adding costs to transportation can restrict lower income households' movement.

Although, over time as cities grow, distances become too far to walk for most people. This is when public transportation takes over, as trains and buses can either have no emissions in consumption, or less per person than cars.

Due to the rising population, public transport needs to be able to accommodate many people. The state of public transport in the UK is questionable in this regard, as high fare prices, frequent delays, and low-quality infrastructure means that public transport might be a limiting factor in convincing people to switch away from cars, particularly in the long term.

Steps are being taken to make public transport a more viable substitute, as the government's new policy to renationalize trains aims to lower fare prices, helping them become more financially viable for everyone, especially lower income families (this is important as they are less likely to be able to afford electric cars).

The Integrated National Transport Strategy aims to make the UK more interconnected. This is important, as people living in rural areas will be more connected to the rest of the UK, and now have less incentive to use cars. Previously, public transport was less present in rural areas, making cars more of a necessity. Improving the reach public transport has helps to reduce dependency on cars.

Following COVID-19, lifestyle changes have been seen within typical office jobs, as people can have the option to work from home. This structural change within businesses has been seen to reduce the amount of travel needed, therefore making people less dependent upon cars. Furthermore, this reduces the number of cars on the road during rush-hour traffic, this means journeys are faster, and less emissions are released per journey. However, this could incentivise the use of cars, as less traffic makes cars a more attractive method of transportation.

Ultimately, urban planning, law and regulation, increased spending on public transport, and lifestyle changes can be used to reduce the overall need for transportation alongside disincentivising cars specifically whilst simultaneously pivoting towards alternative forms of transportation that can result in a greener future. ■

Can religion and reason ever truly agree?

RUBEN POWAR

A *s a Sikh student growing up in modern Britain, I often find myself moving between two ways of understanding the world. One is shaped by reason, science, logic, and critical thinking. The other is rooted in religion, faith, and a deep sense of spiritual meaning. At times, these two approaches can feel like they're pulling in different directions. But do they have to? Or can they support each other?*

At first glance, religion and reason seem like opposites. Reason depends on evidence and analysis. Religion is often about belief in things that can't be proven- like the existence of God, the soul, or life after death. But that doesn't make religion irrational. As the French mathematician and philosopher Blaise Pascal once wrote, "The heart has its reasons of which reason knows nothing." Not everything important in life can be explained by science. Emotions, relationships, purpose, love- these are central to our lives, and yet not always logical.

In Sikhism, there's a strong emphasis on seeking truth, understanding the self, and living with awareness. It doesn't reject logic or science at all- in fact, questioning is encouraged. But Sikh teachings also remind us that the deepest truths can't always be grasped just by thinking.

To me, this isn't saying thinking is bad- it's just limited. Reason is powerful, but it has boundaries. It can explain how the world works, but not necessarily why it exists, or what makes something truly meaningful. It cannot explain the start, the

chemical reaction that we call life. That's where religion often steps in.

Modern Western philosophers have also debated this tension. David Hume, for instance, argued that religion often relies on miracles, which go against natural laws and therefore are not credible. He believed that without strong evidence, religious claims should be doubted. I can understand that view- especially in a world where science has explained so much about the universe.

But other thinkers, like Immanuel Kant, believed that reason itself points us toward ideas like morality and justice- ideas that seem to go beyond simple logic. Kant suggested that there are some things we need to believe in, like freedom and moral responsibility, even if we can't prove them. For me, that makes sense. Many people, religious or not, live as if these deeper values matter. So maybe reason and faith aren't enemies- they just deal with different parts of being human.

In my own life, I don't feel that being religious makes me less rational. I can accept scientific explanations about

the world while still believing that there's more to life than just atoms and molecules. I don't think believing in evolution or space exploration cancels out a spiritual sense of wonder. If anything, it adds to it.

Some people argue that religion causes division or conflict, and that reason is the better path forward. But religion, at its best, offers ethical guidance, inner peace, and community. Reason, at its best, helps us think clearly and solve problems. We need both. When people use religion without thinking, or use science without ethics, things can go wrong.

In conclusion, religion and reason don't have to be at war. They're different, but not necessarily opposed. Reason helps us understand the world; religion helps us understand our place in it. As a Sikh student, I don't see my faith and my thinking as in conflict- I see them as two ways of searching for truth. And I believe that the most complete understanding of life comes when we allow both to work together.

**'The heart has its reasons
of which reason knows
nothing.' / Emotions,
relationships, purpose, love-
these are central to our lives,
and yet not always logical.**





Imperial Education

MRS MCKENNA

I believe that History teachers are particularly fortunate. Not only do we get to teach the best subject in the school, but we also have an organisation which supports our professional development throughout our careers, the Historical Association (HA).

We actually have a whole school membership of the Historical Association for History staff and students. The student section is growing all the time with sections about careers in History, transitioning to university and topic specific information too. You can access this area with the username: 15029 and password: student123.

Through the HA, I have completed a Subject Leaders Development Programme (SLDP), gained Chartered Teacher status and read innumerable articles by teacher researchers and academics providing advice on different topics. However, I am writing to share my most recent professional development experience.

I have taught the AQA History, Component 1J, The British Empire 1857-1967 for 6 years now. I already had a good understanding of most of the main concepts and events as I had studied Empires at undergraduate level. Nevertheless, over the last few years there has been an explosion of thinking and historical literature on the topic. Therefore, I am keen to ensure my students are not only prepared for the examination at the end of Year 13, but also able to engage in debates and educate others on the topic.

For any of us to really understand the historical significance of the British Empire we need to learn about the experiences of colonised people. Subsequently, I have spent the last few years reading and increasing my own understanding. Yet, I was still aware that the weakest area of my teaching was about the economic impact of the British Empire. Despite several conversations with the ever-patient Mr Anderson about a certain Mr Keynes and why the Gold Standard matters, I was still aware there were deficiencies in my understanding of this topic which was having an impact on the quality of the essays my students were producing.

So, imagine my delight to see this in my email inbox one day!

As there were only ten teacher places, I devoted the next few days to completing the application form and fine-tuning the accompanying personal statement, explaining why I would be a good candidate. It paid off as a few weeks later, I was notified that my application had been successful!

The course was split into multiple stages, beginning in April 2024 with a three-day residential at LSE (London School of Economics and Political Science). There, we met with Abdul Mohamud and Robin Whitburn, the course leaders, as well as, LSE academics Professors Tirthankar Roy, Leigh Gardner and Mohamed Saleh, who shared their research with us. The lectures were fast paced and informative and I really enjoyed returning to studying.

Here we are:



Following the residential the programme continued in the summer term with a 12-week online course from May to September. This provided the opportunity for us to build on the foundations from the residential and really engage with the economic impact of colonialism across Asia and Africa. Not all teachers on the Fellowship taught A-level History and there was the expectation that we would all create teaching resources for our own settings, using the learning from the course.

We met again one Saturday in September 2024 at LSE, to present our ideas about the lessons we would be creating, to the course leaders, academics and other teachers. It was great to hear what the other teachers planned to do and to get some advice on my own ideas.

Since then, I have spent any free time creating lessons, trialling them on my poor Year 12 'guinea pigs' and adapting them accordingly.

However, two more related events are worth mentioning before I finish. In March 2025, I received an email from a film crew from LSE asking if we would be willing to feature in a promotional video, sharing the work of the LSE academics and the impact it had had in schools. Once again, my Year 12s were drafted in and good naturedly agreed to be filmed during a lesson. At times,

this involved some very close-up shots but the crew were very complimentary about the professionalism of the students and no double takes were necessary!

Finally, I had the pleasure of presenting my lessons at the annual Historical Association Conference, held in Liverpool this year. It was an honour to share my work which will be published on the HA website in September and humbling to think that other A-level teachers will be using it to teach their students too.

Completion of the HA Teacher Fellowship has certainly been one of the high points in my professional career to date and it shows how we can all continue to learn and become the best versions of ourselves we can be. ■



What would make a harmless bacterium have deadly effects?

HADI AL SHEIKH ALI

B *Bacillus anthracis, Mycobacterium tuberculosis, Clostridium tetani, Shigella dysenteriae: all of which are infamous pathogenic agents which have resulted in catastrophic epidemic outbreaks which required the innovative microbiologists like Louis Pasteur and Robert Koch to resolve. This 2-sided historical interpretation of microbes inhibits are scope to pure focus on these foreign pathogenic intruders; however, what many are ignorant of is the versatile and potentially harmful, yet vital microbial ecosystem which has developed inside species between which is immense phylogenetic separation after eons of co-evolution, first studied by Antoni van Lueewenhoek in 1676 in his visualisation of motile microorganisms from his own oral mucosa.*



The complexity of the cooperative biochemical mechanisms within this ecosystem, which was proposed to be labelled as a separate organ in human physiology, such as the regulation of stimulation of the mucosal immune system in comparison to the systemic immune system in order to maintain the correct levels of populations of certain commensal bacteria in order to prevent selective advantages for pathogenic bacteria is a truly remarkable display of interspecies harmonisation. An ecosystem whose vitality is often cast into the shadows of biology, and whose diversity and pathogenic potentials are equally as ignored. An ecosystem seemingly estranged from scientific comprehension, yet so close and harmonically associated to many species in a symbiotic and mutualistic manner: the gut microbiota.

GENETIC VARIATION IN GUT MICROBIOTA

The mutualistic relationship between the host and symbionts can be quintessentially depicted with the symbiosis that occurs in the mammalian gastrointestinal tract, whose understanding is vital for the subsequent comprehension of the biochemical imbalances that correspond with spontaneous genomic changes or dietary changes. The latter is seen for instance when *Bacteroides thetaiotaomicron* switches from consuming complex carbohydrates in dietary fibres to glycans present in the host intestinal mucus layer when polysaccharides from plants and fibres are absent from the diet, leading to the thinning of the mucus layer, which then paves the way for the development of epithelial and consequently lethal colitis caused by a murine mucosal pathogen. This shows how these various factors can lead to selective pressures put on bacterial populations that can lead to natural selection favouring pathogenic variants.

Investigation into the dynamic nature of the gut microbiota has surpassed the information obtained from previous unreflective culture-based studies. Instead, more precise methods of high-throughput sequencing and phylogenetic approaches based on sequencing bacterial 16S rRNA revealed that the composition of the microbiota in the human distal gut lacks diversity on the basis that it is mainly dominated by 2 out of the 55 subdivisions of the bacteria kingdom: Bacteroidetes and Firmicutes, and 1 member out of 13 subdivisions of the archaea *Methanobrevibacter smithii*. This shows the extensive timeline of coevolution that has occurred between a relatively small number of species and the human host, perhaps due to the early establishment of dominance by particular bacterial kingdoms which has developed into this fortified, resilient mutualistic relationship.



HOW DO THESE COMMENSAL BACTERIA SURVIVE IF THE ROLE OF THE SYSTEMIC IMMUNE SYSTEM IS TO INDISCRIMINATELY DESTROY FOREIGN ANTIGEN-PRESENTING SPECIES?

In order to deduce the means by which commensalism undergoes metamorphosis into pathogenesis, it is essential that the means by which an organism maintains this symbiotic equilibrium is identified, as it is logical to then assume that any factor disequilibrating this homeostasis may lead to the increased binary fission or out competition by a pathogenic subvariant of a particular commensal bacterium. While the systemic immune system is essential for the immunological responses against foreign invading pathogens, the mucosal immune system, which abides by a completely different set of guidelines to the systemic immune system, ensures the survival of the more than 100 trillion microbes present in the gut.

A field of applied mathematics known as "game theory" was used to analyse this relationship and deduced the mammalian-microbial symbiosis to have the greatest resemblance to the "generous tit for tat cooperation system". This describes the cooperation between the host and symbiont with the goal of exacting a mutual benefit; however, the cooperation is dissolved if one party defects, with leniency in the case of inconsistent, "accidental" defection. The mucosal immune system and commensal bacteria have a wide variety of tolerogenic and inflammatory agents which increase or decrease tolerance to commensal bacteria respectively, and both parties continuously deliberate whether the cost to benefit ratio of maintaining this relationship is high enough. It is these tolerogenic factors which allow the mucosal immune system to maintain a healthy level of commensal microbes in the GI tract and dictate which response is appropriate to which bacterium.

This is demonstrated by the capsular polysaccharide: Polysaccharide A (PSA), which is expressed by the commensal bacterium *Bacteroides fragilis*, and has been shown to exhibit immunomodulatory characteristics for both the mucosal and systemic immune systems. PSA results in the stimulation of production of interleukin – 10 by CD4 + T cells, providing protection against colitis. However, it was observed that when *Bacteroides fragilis* was exposed to a systemic immune response, a proinflammatory response was induced resulting in T cell-caused peritoneal abscess formation. This comprehensively portrays the nature of the immune plasticity present within the gastrointestinal tract, allowing T helper cell expression to be dynamically shifted upon stimulation of the systemic and mucosal immune response, preventing numerous autoimmune inflammatory diseases.

EVOLUTIONARY MECHANISM BY WHICH PATHOGENIC STRAINS EMERGE FROM COMMENSAL BACTERIA

A paradigm commensal bacterial species which demonstrates this shift is *Escherichia coli*, with most strains colonising the GI tract being harmless and non-pathogenic, yet the occurrence of genetic, immunological, and environmental adaptivity collectively lead to the establishment of pathogenesis in this usually harmless species, as well as its prolongment.

One way in which the transition from commensal to pathogenic was observed in *Escherichia coli* was experimentally evolving a strain of *Escherichia coli* under particular selective pressures to reveal how the bacterium withstands certain environmental changes in order to express its pathogenicity, which can often evoke changes in the pan genome of a species (entire set of genes within a clade – a monophyletic group), or just simply the cloud pangenome (set of genes found within a particular strain).

In this investigation, the commensal *Escherichia coli* strain was continuously exposed to the threat of macrophage phagocytosis, which led to increased resistance to this immunological threat as it developed pathoadaptive mutations through natural selection which allowed it to develop increased intracellular survival and escape of phagosome mechanisms within macrophages. The transcriptome of the originally non-pathogenic strain was additionally altered by HGT (horizontal gene transfer) which led to the acquisition of virulence genes between individuals of this strain. With this pioneering, yet still very unresearched methodology of experimental evolution, it was observed that, when the commensal *Escherichia coli* was exposed to one of the key defenders of the innate

immune system: the macrophage, *Escherichia coli* clones emerged that provided expressed direct fitness advantage in the interaction with macrophages.

The genomic root of this transformation was caused by mutations caused by IS (Insertion Sequence) insertions at 3 different loci in the evolved clones, one of which was a promoter region of *yrfF* (a regulatory gene which encodes for the production of a regulatory protein that inhibits colonic acid capsule production, which is a type of exopolysaccharide that helps bacteria adhere together and protects against phagocytosis, meaning the evolved forms are less prone to macrophage phagocytosis since IS insertion at this locus switches off this gene and capsule production is unregulated in the absence of them). This further highlights the importance of immunological selective pressure in stimulating this pathogenetic change as these pathogenicity islands – distinct genetic elements aforementioned here which are found on a large number of bacterial pathogens give a selective advantage, so their frequency in bacterial populations increase).

CONCLUSION

In summation, the microbiota found in nearly all kingdoms and in various forms and biological systems epitomise the fundamentality of interspecies cooperation and synchrony in order to produce the greatest possible selective benefits for both the host and symbionts. However, despite the tireless efforts of both host and symbiont to prolong this evolutionary dependency with many biochemical mechanistic measures to maintain a homeostatic relationship, the diverse and unpredictable character of nature will forever prevail, leading to an endless combination of changes in genomic sequence and differing levels of expression of different loci in certain species, subspecies, and even down to the very individual which can lead to imbalance in this delicate system, thus leading to pathogenic expression in previously harmless and essential commensal bacteria. The evolutionary mechanisms by which these organisms adapt serve as the main source of biological understanding on what is such a niche and complex system, perhaps reflecting the words of Theodosius Dobzhansky (1900–1975): “Nothing in biology makes sense except in the light of evolution”. With concision, one can say that despite the phylogenetic distance between the host and symbionts, they strive continuously to maintain this essential mutualistic relationship, but as with all ecosystemic relationships accompanies a sense of fragility and impermanence, perhaps highlighting its irrefutable value to us as something that should not be disequibrated and menaced. It is therefore undeniable that there is universal beauty in that scientific truth. ■



Humour

How political humour, rooted in a sense of identity, can be wielded to transform political power

OLI CALDER

H *Humour stands outside of the traditional political system. In some ways, the traditional political system is primed to reject it, we often view politics as a dignified and austere practice, since the lives of so many rest upon the proper functioning of our political systems, so the light-heartedness of humour may appear out of place. Yet we also identify it as an increasingly common feature of our political experience, and one with robust historical precedent. Often overlooked, as Molière recognised, is the didactic potential of humour, which lends itself to political use. To consider this, I explore how humour transforms both the dynamics of political power and the way that we engage with politics. Ultimately, I argue that humour plays a decisive role shaping political interactions by redefining the way that we relate with politics.*

HUMOUR AND POLITICAL POWER

Beck, in *Ecology and the Disintegration of Institutional Power*, argued that “politics is made in various realms of subpolitics, whether it is in the firm, the laboratory, at the gas station, or in the supermarket”. To Beck, politics was not limited to elections and government; it encompassed all walks of life. We can understand political humour through Beck’s lens of sub-politics. Humour can provide an avenue for the “alternative action” that he describes,

allowing the individual to exercise political power outside of the “formal political system”. The satirical ecosystem matches the template offered by Beck—it is beyond the formal realm of politics, and it is often politically charged. For instance, the BBC’s *Have I Got News For You* combines the light-hearted quiz show format with a panel of comedians and public figures to find humour in current events.² The show is renowned for mocking prominent politicians, including Boris Johnson.³ By leveraging humour, it can provide a sharp critique of policies and politicians themselves. Nonetheless, its satirical

irreverence also expresses a bitter dissatisfaction with the political system. As such, humour can evolve into a form of sub-politics where the individual uses engagement with humour as a political tool to manifest their dissatisfaction.

The ITV programme *Spitting Image* echoes a similar theme. It has caricatured many prolific public figures as puppets, ranging from Margaret Thatcher to Osama Bin Laden. I argue that the absurdity of *Spitting Image* is no accident, and in fact reflects public views of politics and political figures. To some extent, it mirrors the absurdity inherent to political engagement. Few of us will ever meet the public figures depicted in *Spitting*

Image, yet they exercise enormous influence over our lives. We can understand through the reasoning used by Benedict Anderson in his proposal of the 'imagined community' of the 'nation' our connections to each other as a collective political body are largely imagined, and we are unlikely to ever meet most others in our 'nation'.³ This is the absurdity inherent to our political architecture, which *Spitting Image* captures and translates into a form of entertainment by constructing these imagined and caricatured portrayals of political figures. There is also an intimacy to the caricatures that *Spitting Image* depicts. By portraying political figures acting in an undignified or ironic fashion, *Spitting Image* strips them of their distance and detachment from the audience. The political public therefore becomes more intimately involved in the imagined lives of their politicians—our imagined connection to their lives becomes stronger, and the idea of the 'nation' is therefore reinforced. In this respect, humour can become a tool for reflecting the absurdity of our political systems, whilst also fulfilling an appetite for a closer understanding of the politicians whom we will likely never meet.

Political stunts can also be humorous, aiming to draw attention to their cause or to articulate dissatisfaction with the status quo. In the London mayoral election, YouTuber Niko Omilana ran a largely satirical campaign, targeting particularly far-right candidates like Laurence Fox.⁴ Similarly, Count Binface, a humorous outsider candidate, has competed in elections across the UK, including the London mayoral election. He claims to have received over one-hundred thousand votes in total. In these cases, I argue that the appeal of humour lies in its ability to strip the powerful of their weight. By intruding into the political system with the light-hearted humour, Count Binface and Niko Omilana can ridicule the political establishment—humour has the potential to flip the political tables. But there is an underlying solemnity to these ostensibly humorous endeavours.

Count Binface, for instance, prides himself on winning more votes than the far-right Britain First party.⁵ We therefore cannot understand political humour as a shallow or flippant activity. In fact, it appears to represent more of a desperate effort to leverage ridicule and irony as a tool against increasingly sinister political currents, such as the emerging far-right.

"Soviet comedy must mercilessly ridicule and expose those inert and ignorant elements that still manage to find their place on the margins of our daily life."⁶ Nikolai Gorchakov

Yet humour can also be weaponized by political powers to consolidate control. As an art form, Soviet comedy clearly had the social capacity to marginalise undesirable groups (the "inert and ignorant elements"). Gorchakov argues therefore that comedy is a sociopolitical tool with immense power and able to shape society. In contrast with our earlier discussions, it is clear that comedy can in fact be weaponized to constitute the status quo that it may otherwise critique. The subversion of humour to a political agenda as formalised and established as that of the USSR therefore highlights the flexibility and versatility of comedy as a political tool.

However, Soviet attempts to shape a 'socialist comedy' reflect a motif common also to modern critiques of the status quo. Both express and reflect, in some regard, a sense of identity. The bitter mockery of politicians in *Have I Got News For You* expresses an identity detached from the political mainstream, one defined by its opposition to the powerful and the status quo. Similarly, *Spitting Image*, in its portrayals of politicians, aligns with the identity of those detached from the sources of power—those for whom its absurd caricatures are a true reflection of their distance from the arena of the public and the powerful. Count Binface and Niko Omilana, with their electoral stunts, attempt to speak for those who feel estranged from the politics of the status quo; they formally insert into our politics the absurdity that many already people recognise, validating their perspective and their identity. In turn, their antics evolve into statements of social divide between those who ridicule and those who are ridiculed, in an inversion of the traditional power structure. The attempts of Soviet theatre to craft Soviet comedy unified in its pursuit of socialist values reflects an appetite for comedy that reflects identity, and that mirrors a collective social movement; it was an attempt to use humour as a method of social unity. As such, humour in politics often becomes a source of identity—a commentary on who we are in an increasingly uncertain political landscape. ■

CHARLIE CHAPLIN

in

THE *Great* DICTATOR

Produced, Written and Directed by

CHARLES CHAPLIN

WITH

Paulette Goddard

JACK HENRY REGINALD
OAKIE • DANIELL • GARDINER
BILLY GILBERT • MAURICE MOSCOVICH

R E L E A S E D T H R U U N I T E D A R T I S T S



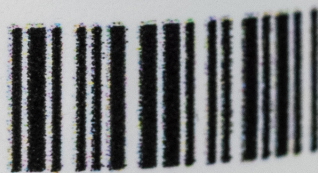
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CORONAVIRUS

COVID-19

VACCINE



For injection only 5ml



How were the Covid-19 vaccines developed so quickly?

OLLY FAWKE

P*andemics have affected humanity throughout recorded time. The longevity of a pandemic and its mortality and morbidity are influenced by a multitude of factors. In modern times, these include population density, faster transport links, modern medical science, rapid communication including public health messaging and organised health infrastructure.*

The development of successful vaccinations relies on understanding the underlying medical science and translating this into vaccine development. It also requires navigation of regulatory processes, funding, public confidence and manufacturing capability.

A review of vaccine development prior to the Covid-19 vaccines would primarily concentrate on the vaccine development process rather than the logistics of vaccine roll out programmes, government involvement in public health messaging and post implementation safety monitoring and feedback. Covid-19 vaccines required a new, much faster way of working.

VACCINE DEVELOPMENT PLATFORMS AND DIFFERENT TYPES OF COVID-19 VACCINES

Vaccine development platforms are technologies that can be used to make vaccines against many different pathogens. They rely on the identification of a pathogen's antigen, which is a unique

macromolecular structure which induces a specific immune response. Synthetic DNA is produced that is incorporated into the cell before following cellular pathways to synthesise the antigenic protein. This antigen is used in the platform technology which enables it to make specific vaccine candidates.

The first three Covid-19 vaccines to be developed were Pfizer (mRNA), Moderna (mRNA) and Oxford AstraZeneca (viral vector). As these were the most rapidly developed, this review will focus on how these vaccine platforms accelerated the Covid-19 vaccine development. Messenger RNA (mRNA) mRNA introduced through vaccination is endocytosed by antigen-presenting cells (APCs). Prior to uptake, it is protected from immune system recognition and destruction by a lipid nanoparticle coating. The mRNA vaccines work by utilising cellular protein synthesis mechanisms to produce the Covid-19 spike protein. This protein acts as an antigen and is presented on the cell surface membrane of the APC. This initiates an immune response during which memory cells are produced priming the immune system for any future contact with this specific pathogen.

The established knowledge of mRNA vaccine development, combined with the new knowledge of the coronavirus SARS-2 gene sequence allowed the mRNA vaccine platform to rapidly produce candidate vaccines. The mRNA technology also prevailed over other technologies as it did not require live cell or viral cultures during the development process.

VIRAL VECTOR VACCINES

The mechanism of viral vector vaccines is defined by the antigenic genetic material of the target pathogen being administered to the body through a different viral particle host, adenoviruses are commonly used as this vector. Once inserted into the cell, the DNA is transcribed and translated to form the antigen, which triggers an immune response. The viral vector is rendered non-replicating by removing at least one gene, meaning that it cannot cause the mild respiratory or gastrointestinal illness it usually would. Prior exposure to adenoviruses means the immune system is primed to attack them potentially making adenoviruses less successful as a vector. To combat this, rare human adenoviruses or harmless adenoviruses that do not usually infect humans are used as viral vectors.

The MERS vaccine which had already been developed using the ChAdOx1 platform and was a replication-deficit recombinant simian adenoviral vector vaccine. This had previously produced a strong immune response from a single vaccine dose and was safely used in children, the elderly and those with pre-existing medical conditions e.g. diabetes. The Covid-19 OxfordAstraZeneca vaccine used the same ChAdOx1 platform.

From the published Covid-19 gene sequence, it was possible to identify the section that coded for the spike protein. As multiple codons code for the same amino acid due to the degenerative nature of DNA, some species predominantly use one codon over another that codes for the same amino acid. Through a process called codon optimisation, viral codons are adjusted so that they are more compatible with the replication and synthesis within human cells whilst still coding for the same primary structure of the spike protein. Prior experience with this technique was combined with computer software that rapidly identified and highlighted codons within the ~28,000 sequence that required swapping. This meant that the optimised DNA for the covid-19 spike protein was completed within one week of the whole Covid-19 gene sequence being shared.

Historically, viral vector methods were slow to

develop due to the arduous process of developing viral cultures for use as vectors; however, during Covid-19 vaccine development, a more rapid approach was taken by Oxford-AstraZeneca. This allowed a shortened timeframe for vaccine development.

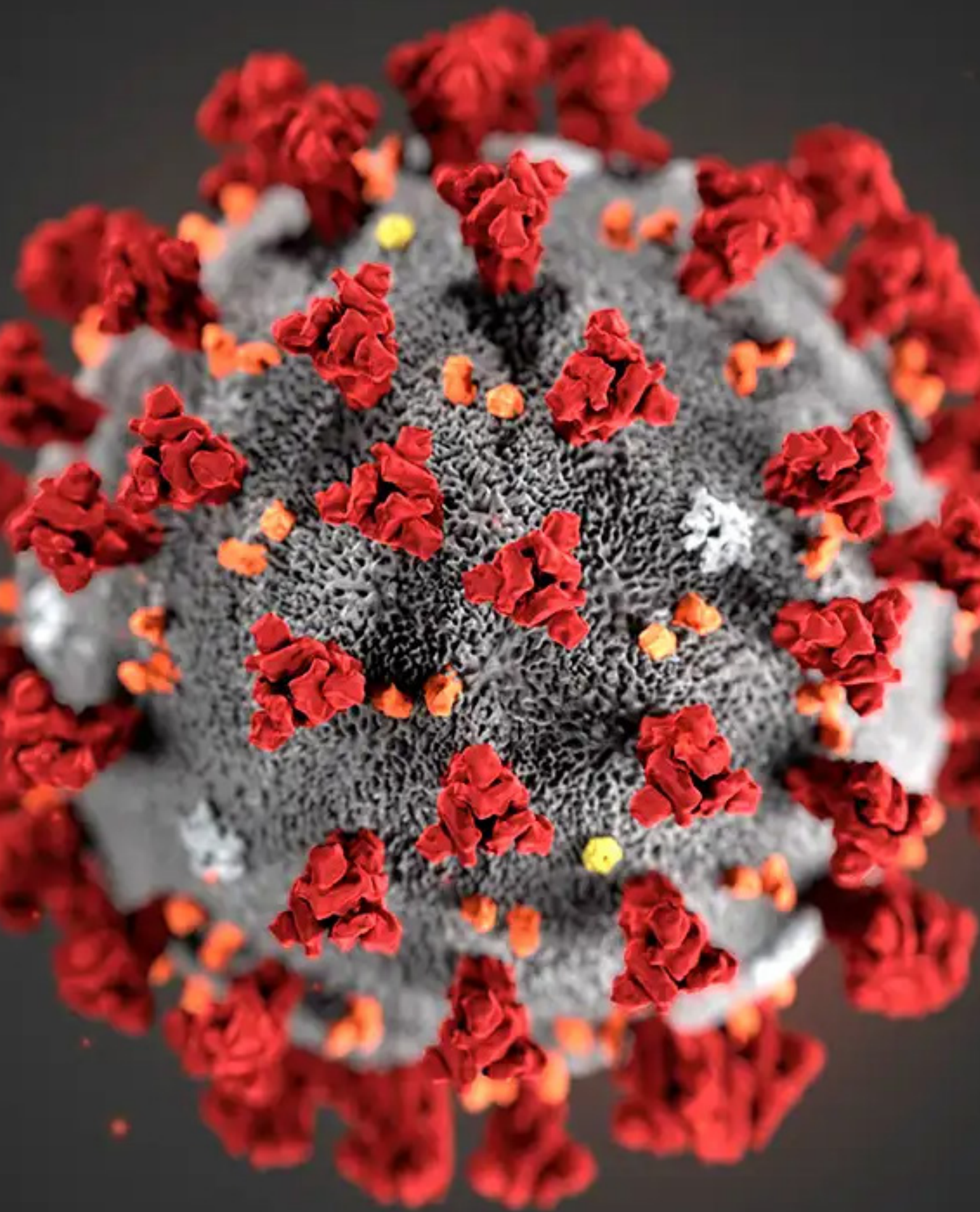
ACCELERATED VACCINE DEVELOPMENT TIMELINES

Prior to Covid-19, vaccine development followed a rigid sequential process which could take over a decade as an initial research phase moved into pre-clinical and then clinical trial phases. Regulatory approval follows and then manufacturing capability is built and vaccine production commences. Phase 4 pharmacovigilance occurs after vaccine release with safety and efficacy monitoring that continues in subsequent years. The key difference in the Covid-19 accelerated vaccine development timeline was the overlapping of the development pathway steps. This accelerated timeline was essential in the rapid development of the Covid-19 vaccines.

Prior knowledge of vaccine development platforms particularly mRNA and viral vector platforms along with early sharing of the Sars-Cov-2 genome allowed a rapid move into pre-clinical and phase 1 testing. Early assessment of initial safety data allowed phase 2 and 3 studies to start very shortly after phase 1 and run almost concurrently. The total time was shorted from over a decade to less than a year.

EXPEDITED VACCINE APPROVAL FROM INTERNATIONAL REGULATORY BODIES

There are multiple regulatory bodies that oversee vaccine safety and grant licences authorising vaccine use. Important ones include the World Health Organisation, the US Food and Drug administration (FDA), the European Medicines Agency (EMA) and the UK Medicine and Healthcare products regulatory agency. These agencies already had processes in place for emergency use authorisation (FDA) and conditional marketing authorisation (EMA) prior to the Covid-19 pandemic. These expedited authorisation processes were used and streamlined. Early Covid-19 safety and efficacy data supported their risk benefit judgement that concurrent vaccine development steps, early vaccine testing and widespread deployment would reduce hospitalisations and save lives. ■



BIBLIOGRAPHY

References are listed by essay in order of appearance.

Are generalist species that look like specialists (Liem's paradox) evolutionary mistakes?

Boag, Peter T., and Peter R. Grant. "Intense Natural Selection in a Population of Darwin's Finches (Geospizinae) in the Galapagos." *Science*, vol. 214, no. 4516, 1981, pp. 82 to 85.

Dawkins, Richard. *The Selfish Gene*. Oxford University Press, 1976.

Liem, Karel F. "Adaptive Significance of Intra- and Interspecific Differences in the Feeding Repertoires of Cichlid Fishes." *American Zoologist*, vol. 20, no. 1, 1980, pp. 295 to 314.

Robinson, Beren W., and David Sloan Wilson. "Optimal Foraging, Specialization, and a Solution to Liem's Paradox." *The American Naturalist*, vol. 151, no. 3, 1998, pp. 223 to 235.

Saarinén, Juha, and Adrian M. Lister. "Fluctuating Climate and Dietary Innovation Drove Ratcheted Evolution of Proboscidean Dental Traits." *Nature Ecology and Evolution*, vol. 7, 2023, pp. 1490 to 1502.

The True Cost of Friendship

Bedford Sixth Form. Student sleep survey.

Survey of university students considering withdrawal on financial grounds, 2021. Publisher and title to be supplied by the author.

Oxford University Press. Study on the diminishing returns of social interaction frequency for wellbeing. Journal, authors and date to be supplied by the author.

How does economics help to explain the high price of a supercar?

Bagwell, Laurie Simon, and B. Douglas Bernheim. "Veblen Effects in a Theory of Conspicuous Consumption." *American Economic Review*, vol. 86, no. 3, 1996, pp. 349 to 373.

Becker, Gary S., and Kevin M. Murphy. *Social Economics: Market Behavior in a Social Environment*. Harvard University Press, 2000.

Frank, Robert H. *Falling Behind: How Rising Inequality Harms the Middle Class*. University of California Press, 2007.

Hoffmann, Jonas, and Ivan Coste-Maniere, editors. *Luxury Strategy in Action*. Palgrave Macmillan, 2012.

Kapferer, Jean-Noel. *Kapferer on Luxury: How Luxury Brands Can Grow Yet Remain Rare*. Kogan Page, 2015.

Kapferer, Jean-Noel, and Vincent Bastien. *The Luxury Strategy: Break the Rules of Marketing to Build Luxury Brands*. 2nd ed., Kogan Page, 2012.

Mankiw, N. Gregory. *Principles of Economics*. 9th ed., Cengage Learning, 2020.

OECD. *Employment Outlook 2020*. OECD Publishing, 2020.

Sloman, John, Dean Garratt and Jon Guest. *Economics*. 10th ed., Pearson, 2018.

Statista. Labour costs as a share of automotive production costs. Statista, 2023.

Veblen, Thorstein. *The Theory of the Leisure Class*. Macmillan, 1899.

The OECD and Statista entries need the exact report titles used by the authors.

What is Quantum Computing?

Google Quantum AI and Collaborators. "Quantum Error Correction below the Surface Code Threshold." *Nature*, vol. 638, 2025, pp. 920 to 926.

Grover, Lov K. "A Fast Quantum Mechanical Algorithm for Database Search." *Proceedings of the 28th Annual ACM Symposium on Theory of Computing*, 1996, pp. 212 to 219.

Peruzzo, Alberto, et al. "A Variational Eigenvalue Solver on a Photonic Quantum Processor." *Nature Communications*, vol. 5, 2014, article 4213.

Shor, Peter W. "Polynomial-Time Algorithms for Prime Factorization and Discrete Logarithms on a Quantum Computer." *SIAM Journal on Computing*, vol. 26, no. 5, 1997, pp. 1484 to 1509.

A Limited Imagination

Anderson, Benedict. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. Verso, 1983.

EF Education First. *EF English Proficiency Index 2024*. EF Education First, 2024.

Home Office. *Irregular Migration to the UK*, quarterly statistical releases, 2018 to 2024. GOV.UK.

YouGov. *Public attitudes towards Channel crossings*, survey results, August 2020. YouGov, 2020.

A Drive for Progress

Department for Transport. *Integrated National Transport Strategy*. Department for Transport, 2025.

Office for National Statistics. *Urban and rural population estimates for England and Wales*. ONS, 2024.

Passenger Railway Services (Public Ownership) Act 2024. The Stationery Office, 2024.

Transport for London. *Congestion Charge: charges, exemptions and revenue*. Transport for London.

The congestion charge traffic reduction and revenue figures need the specific TfL impacts monitoring report.

Can religion and reason ever truly agree?

Hume, David. An Enquiry Concerning Human Understanding, section X, "Of Miracles". 1748.

Kant, Immanuel. Critique of Practical Reason. 1788.

Pascal, Blaise. Pensees. 1670.

Imperial Education

Historical Association. Teacher Fellowship Programme and subject resources. www.history.org.uk.

Mohamud, Abdul, and Robin Whitburn. Doing Justice to History: Transforming Black History in Secondary Schools. UCL Institute of Education Press, 2016.

What would make a harmless bacterium have deadly effects?

Desai, Mahesh S., et al. "A Dietary Fiber-Deprived Gut Microbiota Degrades the Colonic Mucus Barrier and Enhances Pathogen Susceptibility." *Cell*, vol. 167, no. 5, 2016, pp. 1339 to 1353.

Dobzhansky, Theodosius. "Nothing in Biology Makes Sense except in the Light of Evolution." *The American Biology Teacher*, vol. 35, no. 3, 1973, pp. 125 to 129.

Eckburg, Paul B., et al. "Diversity of the Human Intestinal Microbial Flora." *Science*, vol. 308, no. 5728, 2005, pp. 1635 to 1638.

Mazmanian, Sarkis K., June L. Round and Dennis L. Kasper. "A Microbial Symbiosis Factor Prevents Intestinal Inflammatory Disease." *Nature*, vol. 453, 2008, pp. 620 to 625.

Miskinyte, Migla, et al. "The Genetic Basis of Escherichia coli Pathoadaptation to Macrophages." *PLOS Pathogens*, vol. 9, no. 12, 2013, e1003802.

Proenca, Joao T., Duarte C. Barral and Isabel Gordo. "Commensal-to-Pathogen Transition: One-Single Transposon Insertion Results in Two Pathoadaptive Traits in Escherichia coli and Macrophage Interaction." *Scientific Reports*, vol. 7, 2017, article 4504.

Sonnenburg, Justin L., et al. "Glycan Foraging in Vivo by an Intestine-Adapted Bacterial Symbiont." *Science*, vol. 307, no. 5717, 2005, pp. 1955 to 1959.

Humour

Anderson, Benedict. Imagined Communities: Reflections on the Origin and Spread of Nationalism. Verso, 1983.

Beck, Ulrich. "Subpolitics: Ecology and the Disintegration of Institutional Power." *Organization and Environment*, vol. 10, no. 1, 1997, pp. 52 to 65.

Count Binface. www.countbinface.com. Accessed 2024.

"Have I Got News for You." BBC One, www.bbc.co.uk/programmes/b006mkw3.

Marshall, Alex. "Can Britain's Beloved 'Have I Got News for You' Be a U.S. Hit?" *The New York Times*, 13 Sept. 2024.

Moliere. Preface to Tartuffe. 1669.

Oushakine, Serguei Alex. "'Red Laughter': On Refined Weapons of Soviet Jesters." *Social Research*, vol. 79, no. 1, 2012, pp. 189 to 216.

Rack, Susie, and Josh Nevett. "YouTuber Niko Omilana Named as Candidate in 11 Constituencies." *BBC News*, 12 June 2024.

The Moliere reference replaces the Goodreads link supplied with the essay. The Gorchakov quotation is taken from Oushakine.

How were the Covid-19 vaccines developed so quickly?

Baden, Lindsey R., et al. "Efficacy and Safety of the mRNA-1273 SARS-CoV-2 Vaccine." *New England Journal of Medicine*, vol. 384, no. 5, 2021, pp. 403 to 416.

Folegatti, Pedro M., et al. "Safety and Immunogenicity of the ChAdOx1 nCoV-19 Vaccine against SARS-CoV-2." *The Lancet*, vol. 396, 2020, pp. 467 to 478.

Polack, Fernando P., et al. "Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine." *New England Journal of Medicine*, vol. 383, no. 27, 2020, pp. 2603 to 2615.

Voysey, Merryn, et al. "Safety and Efficacy of the ChAdOx1 nCoV-19 Vaccine (AZD1222) against SARS-CoV-2." *The Lancet*, vol. 397, 2021, pp. 99 to 111.

BISHOP RICHARD FOXE
1448 – 1528

SIR WILLIAM CESIL
1521 – 1598

JOHN STILL
1543 – 1608

DR HENRY MORE
1614 – 1687

SIR ISAAC NEWTON
1643 – 1727

COLLEY CIBBER
1671 – 1757

JOHN NEWCOMBE
1684 – 1765

JOHN CUST
1718 – 1770

FREDERICK BARKER
1808– 1882

SIR WILLIAM ROBERTSON
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