The Ratio Club Revisited

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***Abstract* — Inspired by the original Ratio Club and the potential for its multidisciplinary collective and its inspiration by Wiener's cybernetics, we convened a variety of thinkers to a meeting in Manchester and applied the same format. This was done as part of the University of Manchester's cyber security programme. The evening produced thought leadership lessons in debating the epistemology of security in general, cyber security in particular, and the importance of diversity in outlook, discipline and gender for understanding. The discussions of the history of cybernetics, the usurping of its principles by robotics, machine learning, and artificial intelligence, led to a conclusion that we would benefit from meeting again with a variety of interests that would truly promote systems thinking.**

***Index Terms* — Cybernetics. Systems thinking. Multidisciplinary. Interdisciplinary.**

I. Removing the obstacles of naming from the tracks of debate

The University of Manchester has a fine portfolio of expertise and activity in the domain that it often labelled with a fashionable tag of 'cyber security'. This 'tag' is a shame. Because as soon as it is labelled at all, it becomes immediately challenging to attract interest from those who haven't considered themselves connected with, or contributing to, that field to join in, or even to encourage those catalogued as currently working in it to recognise the discipline. Alternative terms such as 'security' (without the adjectival 'cyber' that seems to be accepted by many now as a noun), or 'trust', or heaven forfend – 'digital', have immediate and emotionally charged sectarian effects. Then a whole new level of uncertainty, doubt, and nomenclaturial bigotry emerges as one tries to label the paths to achieving a state of security (another controversial concept) through governance, assurance, or management. So the meta-question has coalesced to be, how does one label 'it' to attract the multidisciplinary talent to set the research questions for a field that may not even exist in its own right?

The term 'cyber' – despite a rather hallucinatory allegory set in science fiction (of which more later) – has emerged from the cybernetics – the science of control and communication (Wiener, 1948). So it was to activities therein that I looked for inspiration on how to drive fresh thinking across the fixed areas of my responsibilities as 'academic coordinator for cyber security' at the University.

Plagiarism notwithstanding, Terrance Dicks once said that 'you need a good, original idea; it needn't however be your good, original idea'. And so my interest in cybernetics encouraged me to work with Colin Williams, of Warwick and De Montfort Universities, to identify and invite a core group to explore the future whilst harvesting the multidisciplinary lessons of the past. I wanted openness and a talisman against preconception and it turned out that the vehicle of British cybernetics – The Ratio Club – had much of what I was looking for[1] (with the immediately noticeable difference on its sign-of-the-time clichéd lack on gender and cultural diversity).

II. Who was 'we'?

When you take the year in view – teaching schedules, examination invigilating and marking, Easter, Christmas and summer holidays – it seems that there is never a good time to try to convene a meeting of a broad spectrum of academics and related disciplines (let alone actually research a topic to a commensurate level of its potential). This was indeed reflected in the invitations. These went out to 27 people. Only one reported no interest. The 15 who attended did so without their colleagues who had prior commitments, one case of flu, but otherwise returned a desire to be kept informed of how the idea developed (and future dates). 'They also serve...'.

So as well as our guest of honour and invited speaker, we were graced by representation from the universities of De Montfort, Imperial College London, Lancaster, and Manchester, and with colleagues from the Information Assurance Advisory Council (IAAC), and the National Cyber Security Centre (NCSC).

Vision

We were fortunate to have the support and enthusiasm for 'the experiment' from our guest of honour, Sir Dermot Turing, nephew of the eponymous imagineering scientist who is credited as a founding father of the field to which cyber security is so often – and stiflingly – linked with.

The original you might say...

Sir Dermot noted the appropriateness of the livery around the historic surroundings in a building commissioned to house the Refuge Assurance Company (1858 – 1996). The

[1] *See Appendix A.*

board room surrounds hired for the evening of 6 December 2017 were doubtless rather plusher than the nurses home basement which was the venue for the original meetings (1949 – 1955 with reunion in 1958. Husbands/Holland). To arrive at the chamber, one passes through the aptly named 'Safe room' (Figure 1) as the 'no professors' rule of the club was intended to support the atmosphere of being able to 'share and challenge ideas 'without being ashamed or afraid'. As these days you can't throw a USB stick without hitting a professor[2], I took the liberty of exorcising this rule. It also reinforces my personal learning favourite of being 'a tail to lions rather than a head to foxes'[3].

Figure 1: The safe room

That 'first rule of Ratio Club' certainly seemed to be too narrow that night and may in itself encourage too much direction of the thinking…which should be 'disruptive… challenging… [with] diversity… variety… boundary violation' (GE) – 'even if you think that your professor may think it stupid…' (CW). Risk taking is to be encouraged here; not something found readily in the risk averse security community (EB). Too often academic structure reviews are a chance to put down 'I think that's a terrible idea' [is allowed] as a review comment (CW). Choosing colleagues/workers with different opinions [is a positive policy] (GE).

INTRODUCTORY TALK

Sir Dermot also suggest the legend about the fireplace (*Figure 2*) might be a protective amulet to protect against the enthusiasm of our guest speaker.

Figure 2: A different perspective on a safe space!

Professor Williams looked at the history of cybernetics and how contemporary computational facilities like the Internet are indebted to the work of J. C. R. Licklider and Vannevar Bush. The proposition at the core of Colin's lecture was that current reality has diverged from the basic work of cybernetics. He suggested that contemporary computer scientists need to know about the history of the ideas they are now working on and how that should lead to better collaboration with neuroscientists, economists, and behavioural analysts.

III. MOTIVATION...WHY WERE WE THERE?

This paper hereon is part record, partly an interpretation of discussions drawn from notes taken during the evening (at the two tables of diners). This analysis may be open to the participants' own [further] interpretation and will – hopefully – have been reviewed by some or all that first meeting in the spirit of The Ratio Club before it becomes 'public'.

Figure 3: By way of introduction

In this vein, it is still with some caution that I have documented the discussions – not necessarily in the order they took place – and open with the challenge of defining the problem we are trying to solve? Questions asked – and statements of intent – included: 'we're trying to stop security breaches happening' or to 'stop problems once they've occurred' and the rather more esoteric consideration of whether security is 'a persistent state' (q.v.) and the idea that this state of security can exist in dynamic systems.

Early agreement seemed to recognise the need for complementary thinking amongst groups without bias. This is against a political background where current government strategy doesn't take enough advantage of government research (NJ). Socially (and economically) too, technology has changed the world more than people thought it would (KS). This is a chance to 'postulate the range of possibilities and probabilities'.

[2] With acknowledgments to Jenny Radcliffe

[3] A saying of Masye ben Horesh and a principle for curating the invitation list.

Figure 4: Colin Williams notes the contrast in venues

IV. THE FOURTH WAVE[4]

What will be the sentience test for a 'non-human biological entity' amongst animals and robots? We are reduced to anthropomorphising humans! (EB) Look at the virtual boyfriend[5] and girlfriend[6] 'craze' in Japan. It's indicative of the virtual bond we develop with technology (GE). Look at Saudi Arabia's allocation of citizenship to a robot…[7]

The first industrial revolution removed the need for human muscle as Plato had suggested that writing replaced the need for memory. Is the current revolution replacing the need for human decision making? When will human input be no longer needed?[8] Like the sorcerer's apprentice, with self-replicating Von Neumann machines, who says 'Stop!'? Look at what happened with Facebook's AI[9].

Do we hand over responsibility for decision making or stop at augmented decision making? There will be cyborgs in the battlespace. There will be no choice but to have cybernetically augmented humans. It is a societal imperative. But what is the motivation…of the machine...of the human…of systems? Are intelligence and consciousness an emergent property? Systems evolve. Can you have intentional, purposeful behaviour in machines? Think of murder v. manslaughter…

Consider the Soviet response to cybernetics – control. Look at Stafford Beer in Chile – Project Cybersyn – and the distributed decision-support system. Behavioral incentives can be manipulated.

Consider what from the past, steers today. Look at the Macy conferences (KS) – the most important conferences never heard of. Participants included Claude Shannon, Norbert Wiener, Milton Erickson, and Gregory Bateson. They embodied cybernetics as an important aspect of systems thinking. Using intellectual horsepower to replace, to reorientate the body of thought. It should be useful to the problem we need to manage, but what we have now tends to diverge into self-perpetuating, self-limiting silos of assumptions that censor methodology by authority and risk stunting the body of knowledge as a result. Silos have their place – what else was Bletchley Park if not a silo? (GE). Critical thinking should not be misused to boil down the problem too early lest we sit in the wrong silos and self-harm with Occam's razor for the sake simplification.

Something like the pithiness of Newton; is that what we want? (JDT) We see failed information technology because the models [used to design and build it] are fundamentally flawed as we fail to appreciate inclusive and diverse views (Carr et al., 2003). Is there something complex that can be applied in simple, manageable quanta? Like the probability of waves and the impact of particles. Metaphors are borrowed all the time (CT). Look at ontology: borrowed by computer science (unsuccessfully) from philosophy. There is plenty of systems thinking e.g. ecology (CT) but the need for the ethos amongst that night's gathering is because it's not common in information systems and cyber security.

How do you become specific enough to attract the computer scientist and mathematician who shun metaphor in favour of mathematical description? In the observable universe, metaphor v. mathematical description is to be found in the cause and effect of narrative (CW). Can we really expect to be 'reprogramming' people? Such activity is seen as evil manipulation and exploitation but look at the apparent difference of Western and Eastern governance arrangements. The western style of governance doesn't support dynamic situations; it is not close enough to the signals. Western governance arrangements have a tendency to be hierarchical; this is not always appropriate especially under conditions of uncertainty where an heterarchy is more adaptable. We plan for what we're afraid of (based on what we've already seen), but what are we *not* planning for? Do we want to know what will happen rather than what could happen? There is a substance of forgetting rather than history made at the moment of telling (NJ).

Perhaps reposit the security question as: 'What might happen to try and stop it?' Plan for when things go wrong,

[4] Alvin Toffler conceptualises the establishment of societal types by washing away predecessors in wave of change in an anthropomorphic model of historical maturity. 1. Survival gave way to the agronomy. 2. Agriculture fights to maintain it place of on the seas of the economy amongst the wave of industry. 3. The third wave is the removal of tangible value and the information economy. The fourth wave may be the battle between the apotheosis of technology and the ecology of Gaia. Will Homo Sapiens emerge as a cybernetic organism or retain its organic identity in the ecosystem?

[5] https://www.vogue.com/article/virtual-romance-apps

[6] http://time.com/3998563/virtual-love-japan/

[7] http://www.independent.co.uk/life-style/gadgets-and-tech/news/saudi-arabia-robot-sophia-citizenship-android-riyadh-citizen-passport-future-a8021601.html

[8] https://deepmind.com/blog/alphago-zero-learning-scratch/

[9] http://www.computerweekly.com/news/450423706/Why-Facebooks-AI-termination-raises-safety-concerns

not if. Organised crime doesn't want the Internet to crash (but that could happen accidentally). Trying to stop security breaches happening is unlikely to succeed; stopping problems spreading once occurred may be more realistic. Can we move beyond today's protectionist mindset of almost totally ad hoc responses?

V. An Emerging interest in Systems thinking

Why don't we use systems thinking to fix the lack of systems thinking? Can systems be defined or not? What are the boundaries of a system? (Wiener v. Hubbard!) Is there a philosophical definition of a boundary?[10]

There are certainly some beacons and attractors such as Ludwig von Bertalanffy (GE) who discussed cybernetics from before holism; a subset of subsystems reflected in cybernetics, Nancy Leveson of MIT (Systems-Theoretic Process Analysis – STAMP Framework), and Peter Checkland's Soft Systems Methodology. Bertalanffy recognises systems theory as a means to address more 'general' problems through a number of approaches including: classical mathematics, computerisation and simulation, compartment theory, set theory, graph theory, net theory, cybernetics, information theory, theory of automata, game theory, decision theory, and queuing theory (GE).

We can't read everything (CT) but there are key texts (CW) – see *VIII Further reading* below – one needs to read Wiener and Ashby to critically discuss cyber.

At the same time, there are the dampeners and detractors and the paradox of indeterminism versus determinism (such as the apparently certainty of retuning to a 'vanilla' build of – say – Windows 10). How predictable is predictable; where is the baseline where randomness may stop? Thinks of what is encoded in DNA. Practical examples can be seen in the introduction of disruptive feedback like misinformation in the battlefield. The need to respond and adapt to attacks. Disrupting cognitions (as exercised in WWII) is not an outmoded concept, even with the greater systems complexity we experience today.

'Killchain' models have tried to generalise the attack' process' but they tend to be viewed linearly and immediately lose their value to understand the attackers who will adapt – or perhaps – regulate - their behaviours. In contrast, the OODA loop (observe, orient, decide, and act) – which is a classic cybernetic construct (CW) presents a mechanism for considering decisions on resilience measures in small eddies of regulation through constraint. Complexity presents itself at scale and determinism is forced down by chaos. Regulation may be taken as the boundary line (JDT) or regulation may be defined as the safe exploitation beyond boundaries: here is the opportunity for cyber – communication and control.

Look at the Deep Mind 'cyberneticists'. Google's cloud platform is actually called 'Kubernetes' and is indicative of the Google approach: a gestalt rather than other providers that see their cloud offering as a separate entity to other services. AI models are based on complexity: Google/Deep Mind/Go/neural networks. John McCarthy – at the Dartmouth Summer School – introduced the artificial intelligence label to discredit cybernetics (CW). Then there is the collaboration promised by Gibson's cyberspace. But the glamour of Gibson's narrative has poisoned what we have now by encouraging alarms about security to be (often deliberately) ignored or never even imagined (DGD) whilst staring rabbit-like into the light of the on-coming electron.

VI. Conclusions

A fear for critical thinking was expressed. The art of critical enquiry has it been lost? There seemed to be the consensus that the evening had ignited sufficient interest to bring like minds together – 'unfettered…untrammeled' – to play with ideas without fears; to bring to bear an understanding of the societal, systemic challenges. To create a forum for 'redressing the balance' perhaps with homeostasis as a sub-heading (or vice versa). Perhaps this paper may evolve along the theme of getting to the level of critical, systems thinking that communities require for cyber resilience – can systems thinking redress the balance?

Cross disciplinary ideas

Is cyber security part of systems thinking? Let's investigate the decision making process by testing reactions (EB). Consider the Turing Test as its real name suggests – a game: when will the attacker give up? A key question is not why some people do bad things but why doesn't everyone? An individual's behaviour is not entirely their own responsibility; think of the influence of others on them.

Behavioural economics may have something to add – decision making in a social context, game theory, rational agents. Look at antimicrobial resistance – will we face the same problem in cyber security?

What should we worry about in augmented decision making? What is its potential effect on capability/resilience? Understanding variability is important in the range of behaviours and more important in discerning average behaviour (EB) as a fundamental principle about knowing how we should design systems?

Perhaps there is a philosophy of cybernetics to be adopted as a framework (JDT). Both sides (technical and social science) are important. But what research can you do to bring both together at same time? (CT). We need tools to think about interaction between humans and technology.

[10] I have previously assumed that the boundary of the system is defined by the limits within which its owner (Checkland, 1981) can have an impact on the effective behaviour and influence of the system in use, and its interaction with other systems. By 'effective' I mean 'will result in measurable change' and by behaviour, I refer to the realisation of functional, non-functional, explicit, implicit, emergent, and derived requirements.

What can we learn from other crisis management areas? Consider the weather analogy: think of chaotic equations. Use an approach of chaotic thinking – global climate cycles versus local weather.

For a shared understanding of what others understand, we need a common set of metaphors across a variety of disciplines.

CONSTITUENCY

The lack of biologists present was noted that night. Resilience – may be more like biology – and needs redundancy. Diversity of team disciplines will bring greater challenges of measurement and methods of showing success but that should be noted as a thing to tackle rather than an inhibitor. Gender and cultural diversity is to be nurtured too.

What should be the ethos of this new Ratio Club? Create a mature understanding of risk? Behavioural economics? International analysis? Game theory? An appeal to government? Perhaps the compensation for the lack of a department of 'networkology' in any university to bring the disruptions together (JDT). Bring in the economists on networking effects. Include the networks of computer science: software-defined networks, physical infrastructure, virtual infrastructure, and the moves from one to another.

Start recovering the spirit; improve capacity to underpin the reality. Recover the origins…compare and contrast…use the tools to map to the current 'orthodoxies' (CW).

We must change how we learn: education v. learning… social dynamics…get the pegs to work to craft their own holes. Either apply scientific knowledge or create new knowledge. Go back to the 'lost train of thought' of Cyber.

VII. FIRST FEEDBACK

From the hearts of the participants:

- 'an inspiring and worthwhile experience; I enjoyed our discussions more than I was expecting, and was encouraged by the progressive thinking I witnessed'
- 'an intellectually stimulating event'
- 'extremely interesting and was certainly a thought provoking and challenging (in the best sense) evening of conversation…'
- 'exactly the sort of thing I went into academia for: putting interesting people in a room, stirring them up, and seeing what emerges'
- 'a lot to think about and I fully intend to follow up some of the threads that Colin drew out in his presentation'
- 'certainly opened some new lines of enquiry for me…Manchester University did a superb job'
- 'a superb evening – congratulations on taking the initiative'

COLIN'S AFTERWORDS

Our gathering in Manchester was an experiment. It therefore carried the necessary risk of failure as well as the intrinsic promise of success. It was conducted in the spirit of both the Ratio Club and of Alan Turing's insight that the capacity of an entity to exhibit novel behaviour in response to an unfamiliar environment is itself a signifier of intelligence. To survive is to adapt. To adapt is to mutate. To mutate requires existence of risk. Not all mutations confer advantage. Not all experiments succeed. It is safe to say that ours did.

The intent is that we now continue along the path we started to clear in Manchester. The proposal is that we establish a regular pattern of three or four gatherings a year. Together we will share food, drink, good company and a vigorous exchange of ideas. Our purpose is to create a space where a free exchange of thought can occur with the effect of stimulating and encouraging an adaptive evolutionary intellectual and behavioural response to the challenges and opportunities of our contemporary, cyber, environment.

VIII. FURTHER READING

[1] Adams, M. D., et al., *Application of Cybernetics and Control Theory for a New Paradigm in Cyber security*

[2] Ashby, W. R., (1957). *An introduction to Cybernetics*

[3] von Bertalanffy, L., *General System Theory* George Braziller, 1968

[4] Carr, M.J., Konda, S.L., et al. (2003). *Taxonomy-Based Risk Identification*, Software Engineering Institute.

[5] Checkland, P. (1981). *Systems Thinking, Systems Practice*. John Wiley & Sons.

[6] Roque, A., et al: *Security is about Control: Insights from Cybernetics*

[7] Weiner, N. (1948) *Cybernetics: Or the Control and Communication in the Animal and the Machine*, MIT

IX. ACKNOWLEDGEMENTS

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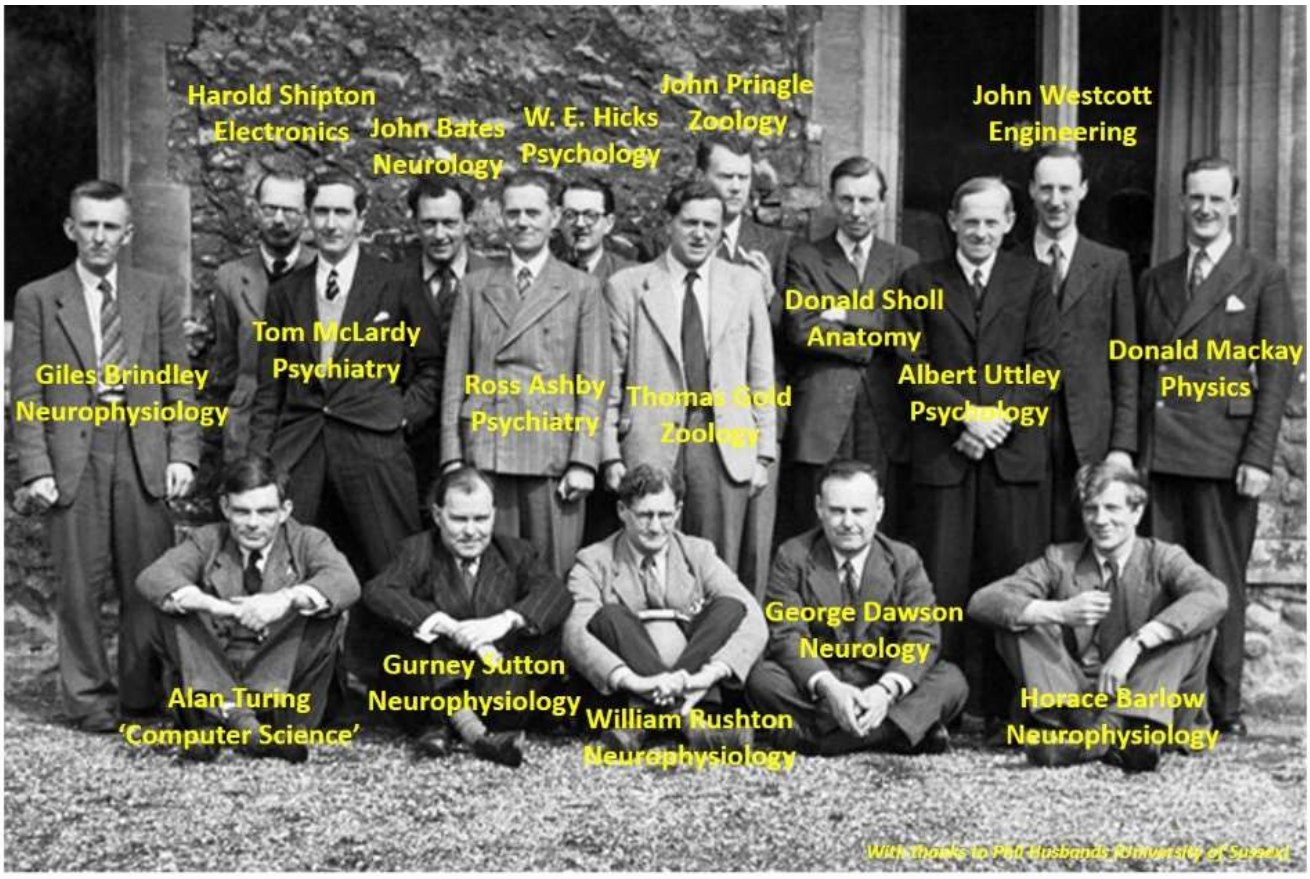
Appendix A.
The [original] Ratio Club
by Professor Colin Williams

On a mostly unremarkable September day in 1949 a most remarkable thing happened in the basement of the National Hospital for Nervous Diseases on Queen Square in London. At around half past six on the evening of the 14th an eclectic constellation of brilliant minds coalesced. Many of the conclave had travelled some distance by steam train across a land still deeply scared by war and most had picked their way through the wreckage of a city still more ruined by the Luftwaffe than repaired by Londoners. At around seven o clock, with synapses suitably lubricated with sherry, they began a lively discussion driven by vigorous cognition in the service of rigorous intellectual curiosity. Both calorific and cognitive appetites were serviced equally. This was a dinner club in the Enlightenment style. This was the inaugural meeting of what came to be called the Ratio Club.



Membership of the Ratio Club was limited to a count of twenty-one. None could be professors. Discussion must flow freely without regard to status or assumed prestige, and must transgress enthusiastically across the fabricated boundaries between invented academic disciplines. All must, in the language of the day, offer 'good value'. Brilliance was rather assumed. The inaugural address at this first meeting was given by Warren McCulloch, one of the giants of the contemporary academic establishment and a thinker recognised today as a principal architect of the foundations of neural networks. The effervescent and untrammeled minds of the nascent Ratio Club found him somewhat disappointing and more than a little pedestrian. As one remarked in latter correspondence to another, McCulloch 'has reached a plateau' and whilst 'flowers that bloom on this alp are worth gathering', nonetheless, 'one should keep one's eyes on the heights'.

Young though they were, these were minds that had been tempered in the furnace of total war. They had rendered science in the service of soldiers. Their list of twenty-eight standing areas for discussion spanned an arc from the sublimely esoteric to the solidly empirical. Thus, question fourteen on their list mused: 'To what extent can the phenomenon of life be imitated by present-day machines?' Whereas question twenty-five enquired: 'What reorganisation of the present economic system would improve it cybernetically?' They understood the power of conscious agency and purposeful behaviour in the world. And now they would play their part in forging a peace fit for heroes.

From this wellspring of youthful courage and adventurous optimism came a flow of intellectual achievement that helped shape their world, ours, and that of those who will follow us. Every beneficiary of an EEG scan owes a deep debt to the Ratio Club. The adaptive cruise control systems in today's cars, and the self-adaptive behaviours of the fully autonomous vehicles of tomorrow, are built on the foundational work on radar produced by Ratio Club minds. From these minds also came several of the fundamental insights underpinning today's machine learning and neural

network constructs. Ratio Club thought is interwoven in the fabric of information theory. Jack Good, author of the concept of the 'super intelligence explosion', together with Alan Turing developed the approach to probabilistic analysis we now know as Bayesian statistics. Turing's work will continue to have a discernible impact on human affairs for centuries to come.

The Ratio Club was the locus of the British manifestation of the cybernetics movement. As such, it was both counterpoint and compliment to the American experience. By the time of its inception the Macey conferences had been underway for a little under a decade. Norbert Weiner had published 'Cybernetics' the year before the first club meeting. The early membership criteria for the club expressed a strident preference for British thinkers who were known to have 'had Wiener's ideas before Wiener's book appeared.' There was episodic direct interaction between the American and the British cyberneticists. Warren McCulloch, Walter Pitts and Claude Shannon all attended Ratio Club meetings. In 1958, Ratio Club veteran Albert Uttley organised Symposium number ten at the National Physical Laboratory in Teddington, London, on the 'Mechanisation of Thought Processes'. The proceedings of the symposium included transatlantic contributions from Marvin Minsky, John McCarthy, Grace Hopper, Oliver Selfridge and Warren McCulloch.

The minds of the cybernetics movement crafted the epistemological and empirical material with which we have wrought Cyber. In which endeavour we have acted according to their telos. Knowingly, or otherwise, we have acted as agents of their will and instruments of their design. It is to these cyberneticists that we owe the revolution in the human condition we call the Information Age. The actuality of our world was first conceived in the imagination of theirs.

Our societies become ever more complex. Our cities concentrate ever greater densities of humans. Our lives, even our biological forms, become increasingly intermixed with information. Humans are changing. The subjugation of the biological evolution of humanity to the conscious will of humans is a credible prediction. Non-human autonomous cognitive entities are gestating. Their birth may not be a foregone conclusion but neither can it be rejected as a whimsical conceit.

To understand our present, we must understand our past. To understand our past, we must know it. To know it, we must first discover it. The foundational cyberneticists shared the common understanding that the application of their designs to the operation of human society was a necessary, although by no means a sufficient, precondition for the very survival of humanity. Let alone for the advancement of the human condition. For Norbert Wiener, the application of cybernetics to humans and their societal structures is required because 'we have modified our environment so radically that we must now modify ourselves in order to exist in this new environment', therefore, 'we can no longer live in the old one.' For Jack Good, the imperative was just as stark and equally existential: 'The survival of man depends on the early construction of an ultra-intelligent machine'.

The task of subjecting the conclusions drawn by the foundational cyberneticists to critical evaluation has become our imperative. If they were correct in their analysis then nothing less than the continued existence of humanity is at stake. If they were wrong then we can cease to worry about the emergence of general AI, relax about the absolute dependence of critical economic and social functions on the Internet, calm down about the use of lethal autonomous weapons in armed combat, fret not about robotic law enforcement, and dismiss entirely concerns about the societal disruption as non-human cognitive actors supersede and displace their biological competitors as drivers, teachers, doctors, surgeons, lawyers, accountants and judges. Is it to Pandora or Prometheus that we should turn?