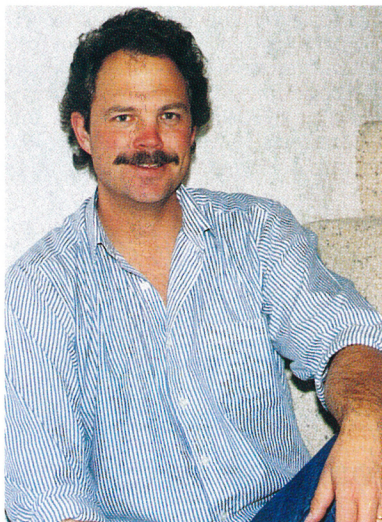




RIBOSOMAL ROBOTICS APPROACHES CRITICAL EXPERIMENTS; GOVERNMENT AGENCIES WATCH WITH MIXED INTEREST

by Jack Watrous
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JACK WATROUS is a computational plasma physicist living and working in Albuquerque, New Mexico. Employed at NumerEx, a small business dedicated to applying numerical simulations to experiments, his current professional activities include involvement with an Air Force Research Laboratory project to develop and apply a parallel three-dimensional particle-in-cell code for high-power microwave research; a project to advance the state of the art of magnetohydrodynamic modeling for pulsed-power applications, funded by Arnolds Engineering Development Center; and several other projects dealing with pulsed-power physics and advanced space propulsion technologies.

He received a PhD in nuclear engineering from the University of Wisconsin—Madison, in 1986. After spending four years at the Naval Research Laboratory in Washington, DC, modeling and analyzing ion beam transport experiments, he entered the fray of research contracting.

His activities outside of work include running and weightlifting, managing a division of 20 youth soccer teams and, with his wife of 16 years, Suzanne, cheering on his two daughters, ages 10 and 12, in their soccer and ice hockey games. On unfortunately rare occasions, he has also been known to write other fiction.

Despite government warnings to the contrary, and a Federal judge's finding that his research may violate the terms of his recent parole, Stephan Tiding has returned to his research at the Mesoscale Physics Institute. Imprisoned nearly ten years ago for violations of the critical self-organizational clause of the Cybernetics Restriction Treaty of 2022 (CRT-22), Tiding has returned with an obvious vengeance not only to his research, but also to his criticisms of government intervention in cybernetics research.

"The 'Big Sleep' of 2021 was no more a conspiracy on the part of a supposedly sentient global computer network than smallpox was a malicious, orchestrated attack on humans two centuries ago," Tiding says. "The one theoretical paper that predicted a phase change in self-organizing cybernetic complexes may well be a valid piece of work, but its application to the Big Sleep was pure junk science. It is extremely unfortunate that our government used that one paper, along with the unfortunate occurrences of 2021, to bolster the public's hysteria about cybernetics; that was how they got the legislation through—junk science and hysteria."

The research article to which Tiding refers,¹ by Samuel Body and his group at Trinity University, suggested that an ensemble of interacting automata would undergo an abrupt change in collective behavior once the size of the interacting population reached a critical level. That level depends on the nature of the interactions between individuals and is extremely difficult to quantify, as is the nature of the behavioral change.

Quantitative behavior researchers, however, did apply the predictions of the Body paper to the global breakdown in interconnected computer systems that resulted in the nightmarish 15 days in August of 2021, referred to ever since as the Big Sleep. "But that was just a backfitting of a theory with many adjustable parameters to known outcomes," says Tiding. "Hence, junk science."

Recent Australian results

Tiding has not commented upon the recent results of the Australian Nanotechnology Group (ANG). At the recent Sydney Cybernetics Conference, Marion Fury, head of ANG's collective effects division, presented results of experiments based on heterogeneous silicon/gallium arsenide nanomachines. "Each unit was capable of attracting or repelling neighboring units through discharge and recharge of onboard capacitors, as well as communicating their position and current status to local 'organizers.' We suspended N such units in a silicon oil, and observed the behavior as N approached the critical population level predicted by the Body paper." ANG's experiment involved roughly half a million of the lowest-level units and about ten thousand of the higher-level organizer units. This population level is the same order of magnitude proscribed by the CRT-22, to which Australia is an international signatory. However, because of the vagaries of the international treaty and body politic, legal action is not expected.

The behavioral change observed in the ANG experiment amounted to

a form of crystallization, says Certain Grep, a cyberbotics researcher currently attached to Tiding's institute. "As the total number of units being added to the population exceeded 450 000," Grep relates, "the whole mixture went into a short-lived state characterized by small-scale vortices. Then, all at once, it congealed into a quasi-crystalline lattice, which revolved about a common axis on a much longer timescale. The ANG folks were understandably pretty busy assuring themselves that a malfunction had not occurred. Indeed, it turned out that 98% of the involved units were still functioning properly and reporting to their local organizing unit. It looked like the real thing—a change in behavioral phase of the type predicted by Body."

A widely perceived problem with the Australian group's approach has been the difficulty in creating individual units that are easy and inexpensive to fabricate, have a tolerably high mean time to failure and are sufficiently compact for critical population experiments to be conducted in laboratory-sized spaces. The heterogeneous silicon/gallium arsenide nanomachines used by the ANG group cost roughly \$1000 apiece, once all fabrication costs are properly accounted for and, under optimal conditions (continuous immersion in a temperature-controlled silicon oil bath), have an individual mean time to failure of 20 hours. A further criticism of the Australian group's approach has been the low degree of functionality of the individual working units, given their high cost.

While useful for research, the ANG's technology does not appear to be well suited to long-term applications. That is one reason why both the US Advanced Research Projects Agency (ARPA) and the Defense Cybernetics Agency (DCA) have had such great interest in the approach taken by Tiding and the Mesoscale Physics Institute.

Protein robotics and then some

"The melding of recombinant DNA technology, programmable protein folding and autonomous computing represents an extremely intriguing approach," says Major General Simon Simon of DCA. "Using protein molecule complexes as the lowest level members of the interacting population is so cost-effective that the mean-time-to-failure issue completely drops out of the picture." In the decades before his highly publicized incarceration, Tiding pioneered and, say some, perfected the technology of programmed protein folding (PPF) and

introduced key applications of collective PPF effects. That technology now finds itself deeply embedded in nearly all aspects of our daily lives, from car seats and bumpers to advanced prosthetics and the high-spring shoes worn by most professional basketball players. The same stimulated folding response, and how it plays out in protein mesocomplexes, serves as a cornerstone in the development of Tiding's multiply interconnected autonomously organizing (MIAO) cybernetics architecture.

Some of his more recent breakthroughs, particularly the creation of self-replicating mesomolecular complexes using hybrid RNA-silicon chains, are what have made him the center of attention in the far-right press. "We are extremely concerned," says Senator Ima Hazbin, the California Republican who chairs the Senate Human Technologies Committee. "Even though his use of silicon chain hybridization in his RNA self-replication process allows him to skirt the directly illegal use of human-equivalent bioprocesses—outlawed since 2012—we feel that his approach still violates the spirit of the law." Bill Terrier, chairman of the Humanity First group, a conservative cybernetics watchdog organization known for its extreme tactics, has likened Tiding's research to that of a modern-day Frankenstein. "If just a fraction of the things we hear about his laboratory are true, he'll soon be breeding his own species of superman in there."

Within the fortress

Urban legend has it that within the impenetrable confines of Tiding's laboratory are colonies of ribonucleic robots that have become entirely autonomous, and have even undergone mitosis. Wilder legends describe some such cyber colonies as sentient, though that harkens back to the hysteria of the early 2020s and the rage against cybernetics popular back then. But within the public's hysteria lie the deeper, more solemn questions of the nature of sentience and whether humans could recognize it in nonhuman collective activity. PHYSICS TODAY put these questions to Tiding in a rare facilities tour and interview he granted us last month.

"The question of sentience is one for the philosophers, I think. Were an ant intelligent, what would it make of a human's heartbeat or respiration?

There are still questions about what the old Internet was doing during the Big Sleep that puzzle cyberbiologists. And what of the supposed long-wavelength signal the WaveNet is said to support—is that just spam-slosh or is it the brainwave of a collective mind, too large for us to perceive?"

The facilities tour took us into laboratories in which hybrid experiments involving recombinant RNA

We've got to find out how sensitive the accuracy of the replication process is to environmental stresses

and silicon chains were being conducted. "Not only do the lowest level working units replicate themselves—I probably shouldn't say 'breed,'" Tiding told us, "but the little darlings can whip up the critical polysaccharide and fullerene structural components used for the mid-level and big boss organizer-controller units. Quality control [in the self-replication process] is one thing we're going after hard. We've got to find out how sensitive the accuracy of the replication process is to environmental stresses. We have some MIAO architecture complexes that actively seek out environments that they fancy, and there's one somewhat controversial study suggesting that a MIAO complex had actually attempted to control its environment. Our hope is that we can train the self-replication process to recognize and adapt to environmental stresses—that's the key for getting these things to survive in some unfriendly places, like the deep ocean and space." Elsewhere, infrared emissions within the protein complexes were being studied. "We got lucky. The way the silicon chain is embedded in the nucleic acid complex gave us a low-energy transition that could open up a whole new communications channel for the working units. Self-absorption of the infrared transition radiation has been shown to induce mechanical folding—but it's a very, very delicate effect."

Tiding then demonstrated a MIAO complex at work. He poured about half a cup of a translucent, violet, gelatinous substance onto the table top. With a handheld infrared controller, which continuously down-

loaded instructions from the local node, he guided the formless glob into a nearly cubic structure from which then emanated a pair of fingerlike protuberances. They extended a distance of about four inches and then closed upon and picked up a paper clip. "This is about as simple as it gets—about a mole's worth of lowest-level working units, a handful of organizer-controllers, next to nothing in the way of autonomous computing. And," Tiding noted, "with no internal ATP storage or conversion, this guy is just about dead."

Our tour ended at a closed door with markings of a level 4 biohazard laboratory within. Gesturing toward it, Tiding said, "There are aspects of our work here that are proprietary, and some aspects are off-limits for good, common sense reasons. But the government forces us to take some just plain silly precautions—like this one, due to the Environmental Protection Agency's highly legalistic interpretation of the lowest-level component of our MIAO architecture as a prionic contaminant."

"But all such nonsense and folklore aside, our upcoming critical experiment will finally demonstrate whether or not a higher order of functionality can be attained by a group as it transcends the so-called Body limit. Whether or not the new behaviors such an ensemble might display verge on sentience is just a matter of definition, and quite irrelevant to our envisioned uses for this technology, should we succeed. As for the legality of transcending the Body limit, we'll be doing our actual experiments using private funds and at an offshore site. We will do what we wish to do."

It is this attitude that has alarmed Federal officials and conservative anticybernetics groups alike. "Stephan Tiding's experiments are a biohazard disaster waiting to happen," says Pleasance Trival of the EPA. "The kinship between the replicating component of his working units and several known human-effective prions is too close to ignore. At least when he's working onshore, we have some assurance that proper biohazard precautions are being adhered to. But when he goes offshore . . ." The Federal judge who oversaw Tiding's parole also spoke out recently: "The terms of parole were very specific in regards to Dr. Tiding's future research activities," said Federal Circuit Court Judge Bright Henway, "and it appears to me that these terms are about to be violated." But it is unlikely that the Federal government will do anything to stop Tiding. Inside sources at ARPA and DCA say

that despite sharing the concerns articulated by Trival, these agencies are extremely interested in the results Tiding obtains as he pushes his MIAO architecture past the Body limit.

The critical experiments are scheduled to begin within the next few weeks. Although the offshore location at which these experiments will be conducted is still a closely held secret, government sources have speculated that Tiding has been in the process

of setting up a laboratory within the Cuban no-fly zone. That would be convenient for Tiding, as not even the United Nations has jurisdiction there. Wherever the experiments take place, much of the world, and particularly the physics community, will be waiting in great anticipation for the results.

Reference

1. S. Body *et al.*, Phys. Rev. **M9**, 112 (2021). ■

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