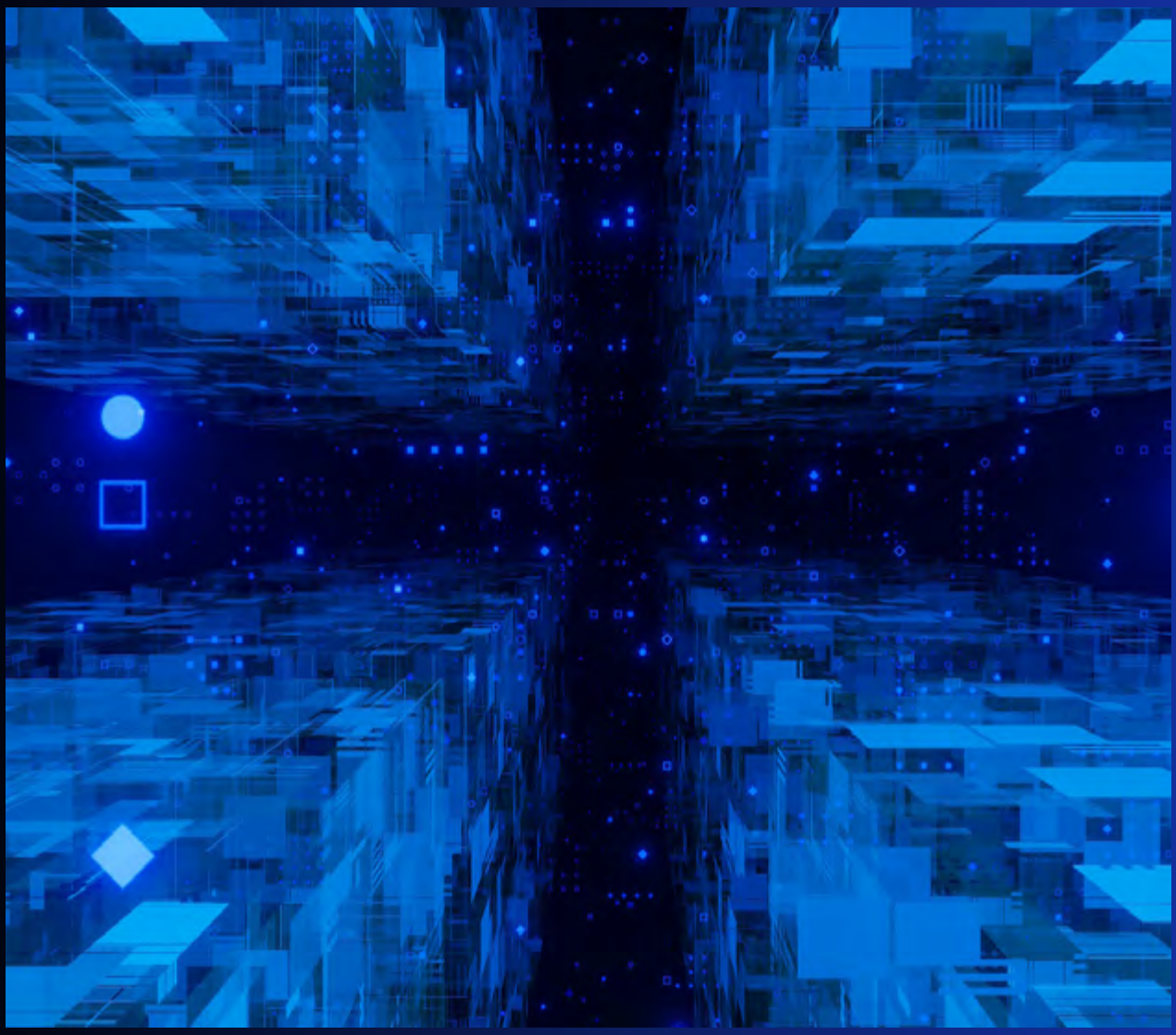
PUBLISHED BY THE CRYONICS INSTITUTE

ISSUE 01 | 2022

CRYONICS INSTITUTE NEWSLETTER

Cryonics insights and information for members and friends of the Cryonics Institute



cryonics.org · info@cryonics.org · 1 (866) 288-2796

CI PRESIDENT'S REPORT

Hello all,

Spring is here, the traditional season of new life so it is an appropriate time to think about the new lives we're all hoping for in the future. Here at the Cryonics Institute we're as dedicated as ever to making that dream a reality. With that in mind, I'd like to remind everyone that as members, we can all do our part to advance our collective mission and to offer up a few suggestions on ways you can get more involved.

Getting more involved with cryonics can be as simple or as advanced as you like, but every little bit helps. Starting with the easy side of things, if you're not a member, please consider joining. If you are a member, consider getting your funding in place and contracting for your suspension. If you've already contracted for your suspension, it is never too early to confirm your funding and start planning standby arrangements. CI offers a wealth of resources to help, so check out https://www.cryonics.org/resources/.

Another thing you can do is to simply mention and discuss cryonics with family and friends if you haven't already. This is, of course, especially important for standby arrangements, but it can also help spread the word and encourage people to better understand and possibly consider cryonics for themselves.

You can also develop your own personal cryonics community and connect with like-minded individuals by joining our members-only discussion group, by following and participating on CI's social media or by joining a cryonics group. Cryonics groups can be especially valuable, as these are often focused on standby support which can directly benefit the members of the group at the most critical stage of their cryonics journey.

In other news, we've completed installation of the LN2 lines at the new facility as well as two cryostats that have been tested and are now ready to receive patients. I'm proud of what we have accomplished with the new facility, but even more encouraged by the simple fact we've grown over the years to the point of needing a second facility to house our patients. What started as just an idea over 60 years ago with the publication of Robert Ettinger's "The Prospect of Immortality" is today a worldwide organization with storage capacity for over 400 patients between our two facilities. That's a profound achievement we can all be proud of and a real testament to the stability and longevity of the Cryonics Institute.

A major part of that longevity is the careful management of our finances. Steve Luyckx, Pat Heller,Joe Kowalsky, and Paul Hagen have done an exceptional job to date, balancing steady growth with safe and reliable investments to insulate CI from market fluctuations like we're experiencing now and to ensure we remain strong well into the future. We currently invest most of our money 75% in passive index funds and 25% in conservative actively managed money. We are happy with returns and while we anticipate short term corrections, we obviously invest for the long term and believe that if cryonics is to succeed that future progress will drive both the markets as well as biomedicine necessary to revive patients some day.

In other operational news, CI has hired a new perfusionist and office worker, Branson Peacock, who has extensive experience in the funeral industry. Kristen Orme has moved on to a different company taking on a more active role in the traditional funeral service industry. She will still operate on

call as needed. Good luck to Kristen and a warm welcome to Brandon. We're looking forward to having him on board as a member of the CI Facility Team.

Regarding other cryonics service providers, I am happy to see the progress with Southern Cryonics in Australia who are very close to opening up soon, as well as Biostasis in Europe. My hope is to see these organizations not only succeed and flourish in the business of long term storage but to provide much needed patient standby in their regions. Adequate standby is one of the biggest challenges of successful cryopreservation that we all face.

A less encouraging story many of you may be aware of is the unfortunate Kriorus situation playing out, which I sincerely hope will be resolved or at least stabilized on behalf of the patients entrusted to the now two separate organizations very soon.

If you haven't read the reports, this story goes into the details of the situation as of April 9:

https://www.thedailybeast.com/russian-cryonics-couple-danila-medvedev-and-valerija-udalovas-bad-breakup-led-to-heist-of-frozen-brains

Obviously, this is not a good look for Kriorus or the greater cryonics community as a whole, especially considering the sensationlist spin on this particular story.

However, I wish both parties the best and sincerely hope their first priority is the proper care of their patients. I also hope that we can all learn from this situation in a positive way. I believe a strong set of organization bylaws and a board of directors like CI has are paramount to ensure patient security thorugh proper succession of leadership and control. Having multiple layers of backup when it comes to key positions and operations is a necessity. It's not a matter of if things will go wrong but rather when, but we can look ahead and either prevent or at least prepare for potential issues.

We also need to learn from both our own and others' successes and failures. Early Cryonics was a pay-as-you go proposition and this lead to the infamous Chatsworth disaster. As bad as that was, we all learned that we had to charge for cryonics up front and that proper investment was how to stay in operation indefinitely. I urge all new cryonics service providers to have succession plans in place for who will take over and how patient care will be maintained past their founders' own lives and abilities.

To close on a more positive note, I would like to report that I will be representing CI June 3-5 as part of a Cryonics "President's Panel" at Alcor's 50th Anniversary Conference. Alcor is advertising this as the first-ever Presidents' Panel, bringing together the heads of four cryonics organizations: Patrick Harris, myself, Emil Kendziorra, and Peter Tsolakides. This is a great example of growing relationships and building cooperation between our organizations, and I'm excited to have the opportunity to network with the leadership of the major cryonics organizations one on one and to also address the conference audience during the panel. I am also planning to use this platform to emphasize the importance of standby and to share my honest thoughts on the challenges facing cryonics we all share moving forward.

Please remember to plan for and stay active in cryonics. This is your life raft and you need to help build it so you can have the best chance for the future.

Dennis Kowalski - CI President

CRYONICS INSTITUTE MAGAZINE
The digital newsletter of the Cryonics Institute
24355 Sorrentino Ct.
Clinton Township, MI 48035-3239

Phone: 1 (586) 791-5961
Toll-free: 1 (866) 288-2796 (North America)
FAX: 1 (586) 792-7062
Email: **info@cryonics.org**

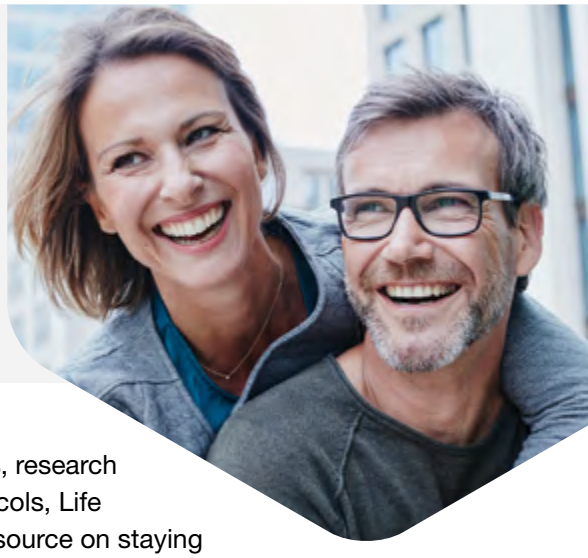
ARTICLE SUBMISSIONS

Cryonics Institute or cryonics-related articles are welcome. Submissions: **dg@cryonics.org**

E-SUBSCRIPTIONS

* As a CI member, you are automatically added to our email reminder list. To unsubscribe, please use the "unsubscribe" link at the bottom of your email.

Get the world's premier publication on prolonging youth & longevity for ONE YEAR, ABSOLUTELY FREE!



PROD CODE: SUBCOMP

Packed with the latest medical findings, research results, and innovative treatment protocols, Life Extension Magazine® is the ultimate resource on staying healthy and living longer. Call now and get a one year subscription (12 issues) absolutely **FREE** ... that's a whopping **$59.88 off** the newsstand price! And it's brought to you by the global leader in the field of preventing age-related disease for over 40 years.

Stay healthy with the highest-quality supplements money can buy.

Life Extension® is the only supplement brand solely dedicated to helping you live a longer, healthier life. Our premium-quality products are based on the latest clinical studies — made with pure, potent ingredients at the same scientifically validated dosages used in those studies—providing superior products for a better you!

Don't just guess what your body needs.

Our expert team of Wellness Specialists can answer your health-related questions every day of the year. And they'll gladly create a regimen of nutritional supplements, diet, and exercise that's customized for your needs.

Get more with Your Healthy Rewards.

With our FREE rewards program you earn valuable LE Dollars back on every purchase you make.* No membership required. For details, visit **LifeExtension.com/Rewards**.

Subscribe to Life Extension Magazine® for **FREE** today!

Call toll-free **1-888-833-8565** to speak to a live operator at any time.

Or, log on to **LifeExtension.com/CI**

You must mention **Discount Code AVX220A** to get these savings • Offer expires February 1, 2023

LIFE EXTENSION®
The Science of a Healthier Life®

Your LE HEALTHYREWARDS

These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.

MKAQTP180401

Membership Benefits

Why join the Cryonics Institute?

The choice is clear: Irreversible physical death, dissolution and decay, or the possibility of a vibrant and joyful renewed life. Don't you want that chance for yourself, your spouse, parents and children?

1) A Second Chance at Life

Membership qualifies you to arrange and fund a vitrification (anti-crystallization) perfusion and cooling upon legal death, followed by long-term storage in liquid nitrogen. Instead of certain death, you and your loved ones could have a chance at rejuvenated, healthy physical revival through cryopreservation.

2) Affordable Cryopreservation

The Cryonics Institute (CI) offers full-body cryopreservation for as little as $28,000.

3) Affordable Membership

Become a Lifetime Member for a one-time payment of only $1,250, with no dues to pay. Or join as a Yearly Member with a $75 inititation fee and dues of just $120 per year, payable by check, credit card or PayPal.

4) Lower Prices for Spouses and Children

The cost of a Lifetime Membership for a spouse of a Lifetime Member is half-price and minor children of a Lifetime Member receive membership free of charge.

5) Quality of Treatment

CI employed a Ph.D level cryobiologist to develop CI-VM-1, CI's vitrification mixture which can help prevent crystalline formation at cryogenic temperatures.

6) Standby Options and Assistance

CI's use of Locally-Trained Funeral Directors means that our members can get knowledgeable, licensed care. Or members can arrange for professional cryonics standby and transport by subcontracting with **Suspended Animation, Inc** or **International Cryomedicine Experts** (I.C.E.) Ci also offers Standby Training Materials and Kits for members who choose to perform Local Standby.

7) Affordable Funding Options

Cryopreservation with CI can be funded through life insurance policies issued in the USA or other countries. Prepayment and other options for funding are also available to CI members.

8) Cutting-Edge Cryonics Information

Members receive a free e-subscription to the Cryonics Institute Newsletter, as well as access to our Facebook page, Twitter feed, YouTube channel and an official members-only forum.

9) Helpful, Professional Support

CI's professional staff is available to answer any questions and address any concerns you may have about CI, your membership or Cryopreservation.

10) Additional Preservation Services

CI offers a sampling kit, shipping and long-term liquid nitrogen storage of tissues and DNA from members, their families or pets for just $98.

11) Support Education and Research

Membership fees help CI to fund important cryonics research and public outreach, education and information programs to advance the science of cryonics.

12) Member Ownership and Control

CI Members are the ultimate authority in the organization and own all CI assets. They elect the Board of Directors, from whom are chosen our officers. CI members also can change the Bylaws of the organization (except for corporate purposes).

CRYONICS INSTITUTE
Technology for Life

To get started, contact us at:

(586) 791-5961 • email: info@cryonics.org

Visit us online at www.cryonics.org

CRYONICS INSTITUTE
Technology for Life

Member Readiness Checklist

You've signed up for cryonics - what are the next steps?

Welcome Aboard! You have taken the first critical step in preparing for the future and possibly ensuring your own survival. Now what should you do? People often ask "What can I do to make sure I have an optimal suspension?" Here's a checklist of important steps to consider.

- ☐ Become a fully funded member through **life insurance** or easy pre-payments

  Some members use term life and invest or pay off the difference at regular intervals. Some use whole life or just prepay the costs outright. You have to decide what is best for you, but it is best to act sooner rather then later as insurance prices tend to rise as you get older and some people become uninsurable because of unforeseen health issues. You may even consider making CI the owner of your life insurance policy.

- ☐ Keep CI informed on a regular basis about your health status or address changes. Make sure your CI paperwork and funding are always up to date. CI cannot help you if we do not know you need help.

- ☐ Keep your family and friends up to date on your wishes to be cryopreserved. Being reclusive about cryonics can be costly and cause catastrophic results.

- ☐ Keep your doctor, lawyer, and funeral director up to date on your wishes to be cryopreserved. The right approach to the right professionals can be an asset.

- ☐ Prepare and execute a Living Will and Power of Attorney for Health Care that reflects your cryonics-related wishes. Make sure that CI is updated at regular intervals as well.

- ☐ Review the **CI Standby Manual** and other materials designed to help you with you Standby Planning. Also, consider joining or forming a local standby group to support your cryonics wishes. This may be one of the most important decisions you can make after you are fully funded. As they say-"Failing to plan is planning to fail".

- ☐ Always wear your cryonics bracelet or necklace identifying your wishes should you become incapacitated. Keep a wallet card as well. If you aren't around people who support your wishes and you can't speak for yourself a medical bracelet can help save you.

- ☐ Get involved! If you can, donate time and money. Cryonics is not a turnkey operation. Pay attention and look for further tips and advice to make both your personal arrangements and cryonics as a whole a success. The stronger our organization is, the stronger your chances of success.

- ☐ Keep your records, contact information and contracts up to date. It is recommended you review your relevant information annually at a minimum. One way is to schedule time to review all your materials at the same time you submit your required Annual Proof of Funding to CI. Also, Be especially aware of easy to forget things like a new email, phone number or address. Remember, you can also contact us at any time to ask if you have any outstanding paperwork or other info that needs to be updated.

  The online **CI Members' Information Form** is a great resource for updating your current information on file.

CI NEWS

What's happening at the Cryonics Institute

New Facility Update

Contractors install the Liquid Nitrogen lines in the new facility. The new, larger bulk tank is expected to be installed at the main facility sometime in May. At that time, the current tank will be moved into service at the new facility.

(left) Cryostats built, tested and ready to be moved into position. (Above) Completed cryostats ready to receive patients. Note the catwalk assembly and LN2 lines in place to service these new cryostats.

There are currently 222 patients at the main facility with room for approximately ten more. The new facility should essentially double our patient capacity.

CI NEWS

What's happening at the Cryonics Institute

T2 Scholarships Available

Scholarhips now include RAADfest 2022

****

Exciting Notice to ALL T2's (Teens & Twenties) - Fully Contracted and Funded Young (12-30 years young) Cryonicists

Bill Faloon has offered to include full entrance to RAADfest (Revolution Against Aging and Disease) 2022 in addition to the regular T2 scholarships (flight, lodging, meals, registration).

RAADfest 2022 will be held in San Diego from Thursday through Sunday, October 6 - 9, 2022. T2 13 2022 will begin on Sunday evening, October 9, and continue all day on Monday, October 10.

As usual, 40 scholarships are offered to teens and twenties, plus RITs (Replacements In Training) and DAs (Distinguished Alums). Also, as usual, fully contracted and funded OSSLAP members are invited to attend at their own expense for transportation and lodging - meals and registration are covered. The goal will continue to be for everyone to get to know each other - as well as being updated on the latest science and technologies from Bill. Many valuable connections have been made over the last 12 years.

For hose interested in applying, please answer ONE MAJOR QUESTION in your email.

Please let us know your preference if you want to attend both RAADfest and T2 13 2022 OR attend T2 only.

Those who respond within the next week will have first priority to the 40 scholarships.

To apply, please send your response to BOTH Kathy Markell - again, as usual and Mark Loucks.

kmarkell@lifeextention.com

kmarkell@lifeextention.com

marc@marclaucks.com

A detailed registration form and program will follow.

Forever,

Cairn Idun
Founder and Director, Teens & Twenties: Getting to Know You; You Getting to Know Each Other

PS: Your T2 Social Zoom will take place on Saturday, April 30th, 2022, from 10am to 3pm Pacific time. Notify Marc Laucks if you wish to receive further details. All T2's past and present are invited to the T2 Social Zooms.

****

CI NEWS

What's happening at the Cryonics Institute

Cryonics Video Wishes - an extra layer of security

Some time ago a well known and long time cryonics member who supported cryonics over many years with time and money passed away and was cryopreserved.

Some confusion about his last wishes came up with a family member who had entertained the idea that maybe the member had changed his mind about cryonics. Since the patient in question had lost the ability to communicate just prior to death and he had left this family member as his Power of Health Care Attorney, he was facing the real possibility of not being suspended. You can never be too sure about who you pick for POA when it really matters, so make sure you trust them completely, quiz them and let them know the consequences of not following your wishes.

However, one very clever extra layers of protection that this member had put into place was a video reiterating his cryonics wishes in which he expressed specifically that he would never change his mind about cryonics. When faced with this powerful video evidence and in the presence of additional friends and family the Health Care Power of Attorney backed down and the suspension was carried out successfully. This is a clear example of being extra careful and of the good planning that this member took in advance. You never know what level of planning will come into play but it is nice to have it when you need it.

After seeing how effective the member's video was at a crucial time, I promised myself I would make a similar video and update it as needed. My next step was to give a copy to the Cryonics Institute so if they ever needed it they could use it as yet another tool in the toolbox to go to battle for me if required. I would certainly hope that it would not be needed but just knowing that it's there to provide a clear record of my wishes straight from my mouth gives me some additional peace of mind.

So **finally** here it is … I made the video. I hope to lead by example and provide it to you all as a useful template. It need not be copied exactly, but if there are some things you find useful please use them. Feel free to add or take away from my example to create your own personalized video that fits your circumstances. Perhaps having it reviewed by family and an attorney might help. In any event, family or next of kin should be made aware of it and a copy should be sent to CI for your file. Please do send us suggestions on what I could add to this template or anything that you would like to do different or consider.

In mine I included....

- My name and purpose of the video
- Declaraion of wishes both now while I am in sound mind and in the event of my not being able to speak for myself.
- Reiteration of my wishes in regards to changing my mind
- Objection to autopsy or plea for a minimally invasive autopsy if one was legally required
- Uniform anatomical gift act or wishes to donate to science my body
- Proper carrots and sticks for supporting vs hindering my cryonics wishes
- Final appeal for speed, cool down and professionalism

Here's a link to my video.

https://www.dropbox.com/s/gda734szcq08jhq/Dennis%20J%20Kowalski.mp4?dl=0

I hope it inspires you all to act and hopefully together we will come up with a best scenario video template that will help us all.

Best Wishes,
Dennis

CI NEWS

What's happening at the Cryonics Institute

Pet Cryosuspension Services Available

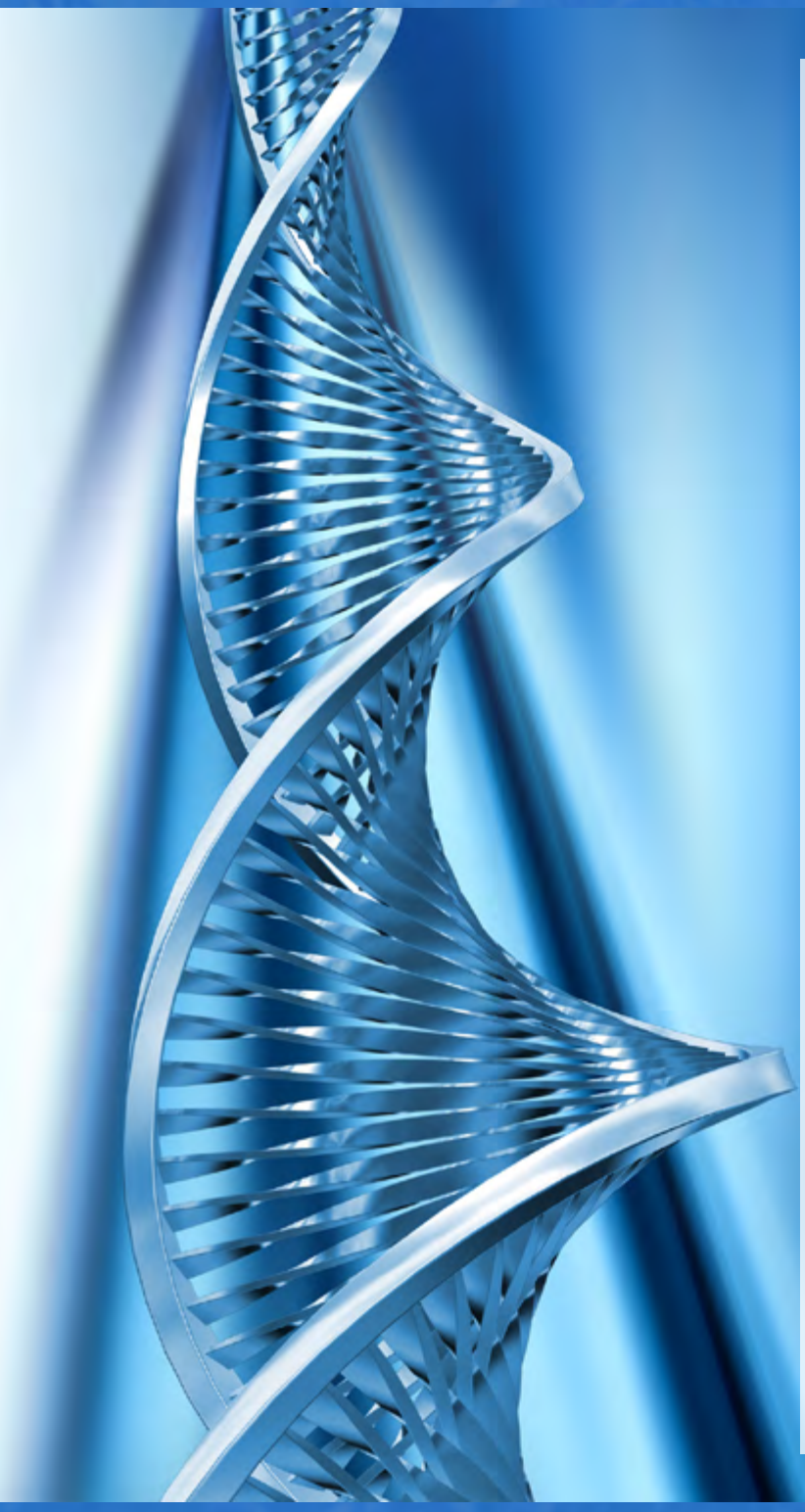
Did you know CI Members can take advantage of our cryonic suspension services for their pets? Instead of burial or cremation, you can give a loyal and beloved pet the same second chance at life that we have through cryopreservation.

Many members who have preserved their pets say it's a comforting thought that their longtime animal companions now have the same chance to live again in a better future. Ci currently has nearly 200 pets in cryosuspension.

Cryopreservation of pets is only available to Lifetime and Yearly Members of the Cryonics Institute. Excluding the cost of Membership, the typical cost of cryopreserving a cat or dog is $5,800 up to 15 pounds in weight plus $150 per pound for every pound above 15 for dogs. This does not include shipping and veterinarian expenses. CI will also preserve other types of pets and pricing is similarly by the size and weight scale for dogs. Please contact us to inquire about specific pricing and procedures for pet patients, or visit https://www.cryonics.org/resources/pet-cryopreservation for more complete details.

CI NEWS

What's happening at the Cryonics Institute



DNA and Tissue Sample Preservation Services

Lifetime and Annual Members of the Cryonics Institute can have DNA / Tissue Samples cryopreserved by CI. Annual Members must have fully paid for no less than one year, i.e. have paid $120 yearly dues (plus the initial $75 initiation fee if it is their first year) for a full year's Membership.

CI provides a DNA sampling kit for hair, skin, and/or inner cheek samples from living persons or pets. Tissue samples may be extracted from a deceased person or pet by a funeral director or veterinarian, respectively. A CI Member may store DNA/tissue for $98 for four samples that will each fit into a 1.8ml sample vial. Some members choose to store larger samples, which cost more and that cost is calculated based on the sze of the sample. The cost includes a DNA sampling kit which consists of four 1.8-milliliter nalgene vials, swabs, instructions, tissue storage contracts and labels that can be placed on the vials, along with a mailing envelope. Each nalgene vial can be individually labeled for content. Each full kit is labeled, identified by a tissue storage contract and stored in liquid nitrogen at the Cryonics Institute.

Tissue samples need not be sent to CI in the DNA sampling kit. Any small vial or container can be used, and CI will transfer samples to nalgene vials for storage in liquid nitrogen.

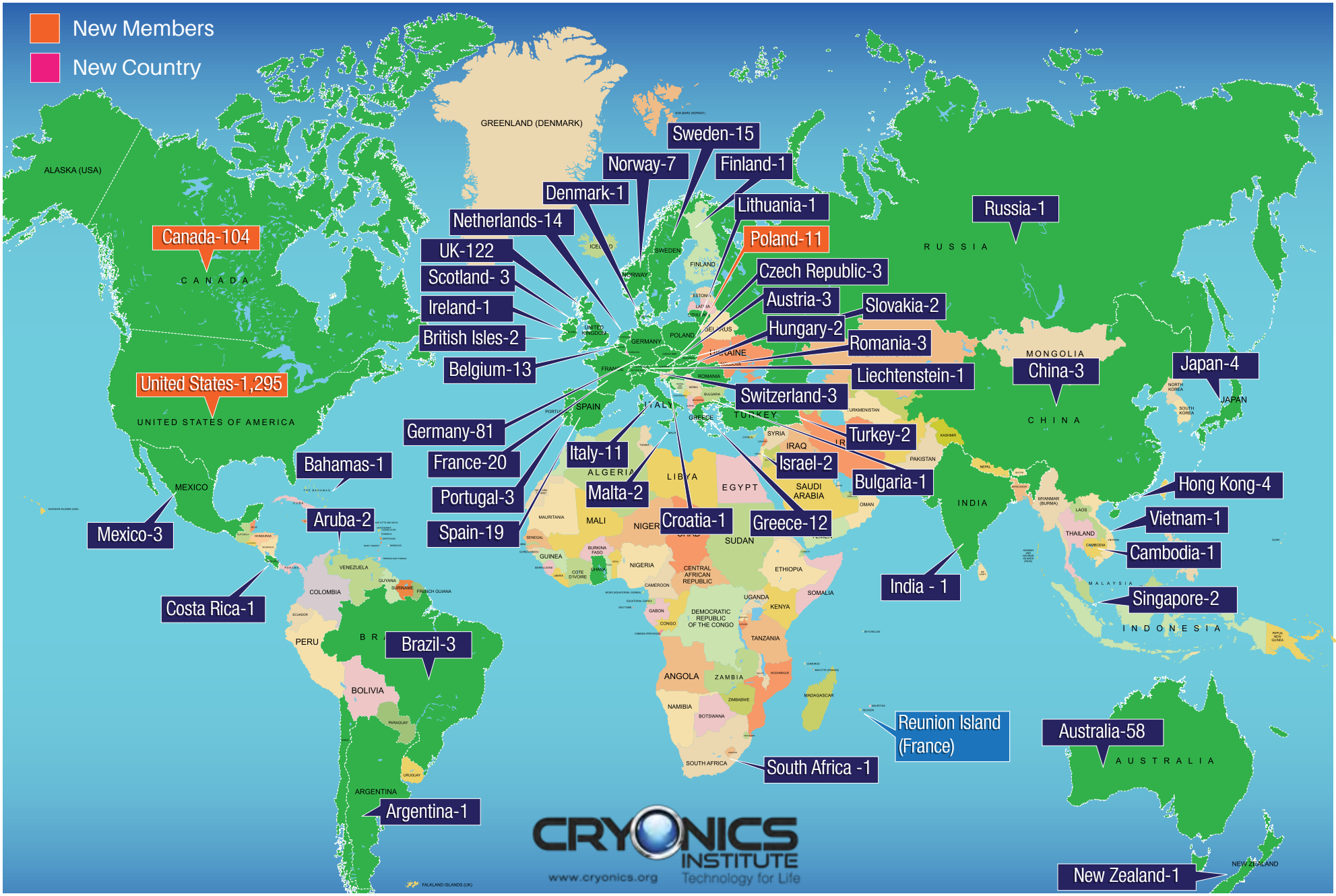
For more information on DNA and Tissue Storage Cryopreservation, please contact us at info@cryonics.org or visit cryonics.org:

CI MEMBERSHIP

APRIL 2022

Members	1,853	Pets	226
Patients	222	DNA/Tissue	338
		SA	305

TOTAL **2,085**



Who will be there for YOU?

Don't wait to make your plans. Your life may depend on it.

Suspended Animation fields teams of specially trained cardio-thoracic surgeons, cardiac perfusionists and other medical professionals with state-of-the-art equipment to provide stabilization care for Cryonics Institute members in the continental U.S.

Cryonics Institute members can contract with Suspended Animation for comprehensive standby, stabilization and transport services using life insurance or other payment options.

SA Suspended Animation

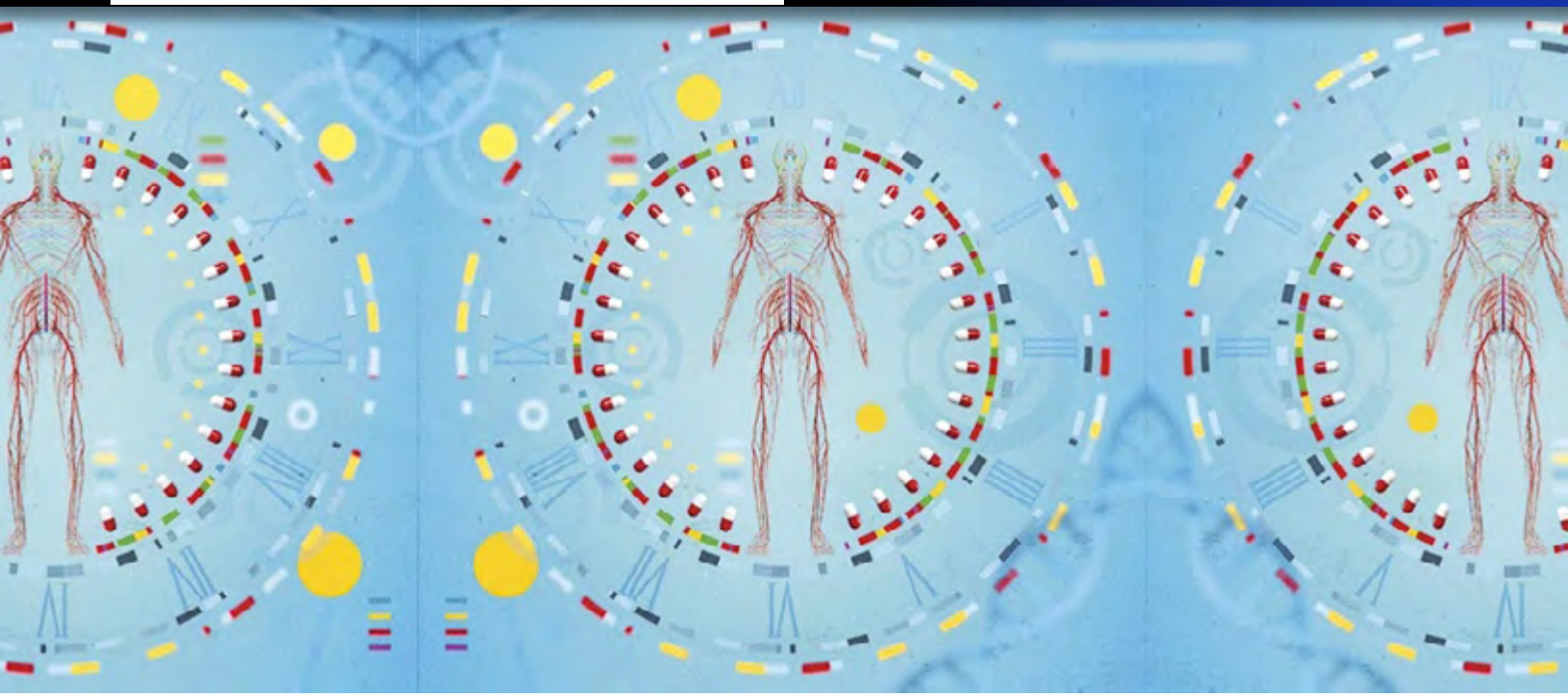
Speak to a medical representative for more information.

Call 1-949-482-2109

or email info@suspendedanimationinc.com

MKMCAD160205 216

Science Focus
THE HOME OF BBC SCIENCE FOCUS MAGAZINE
from SCIENCEFOCUS.COM



Anti-ageing pills are real, and some of us are taking them without knowing it

By Helen Pilcher | Published: 18th March, 2022 at 16:00

Eternal youth is the stuff of religion and mythology, but what if we could just have a bit more of it? What if there was a pill that could slow down the ravages of time, so that you could feel younger for longer. It sounds like snake oil, but there's a growing body of research that's betting on making it a reality.

Picture the scene. After a routine blood test, you visit your GP for the results. "It's all good," says the doctor reassuringly. "The only problem is that you're getting older." Then, with a flourish of the prescription pad, the doctor adds: "But I can help you with that. Take these tablets. They'll slow the ageing process and help you to stay healthy. Oh, and they might just make you live longer too."

A drug that extends your life, slows ageing and staves off the ravages of old age, including frailty and disease? It sounds too good to be true, and yet, an increasing weight of evidence suggests not just that these drugs are within reach, but that they may already be here.

Some can be found on the shelves at your local health store, while others are drugs for conditions such as diabetes and cancer that are being repurposed. Animal studies have demonstrated their potential, and now clinical trials are beginning to assess if their promise holds true in humans. If it does,

those who are middle-aged now could become the first generation to benefit from their use. Imagine an 80-year-old with the biology and 'get up and go' of someone 30 years younger. How joyful not to have to act your age!

Read more about ageing:

The race to stop ageing: 10 breakthroughs that will help us grow old healthily

Instant Genius Podcast: The science of ageing, with Dr Andrew Steele

Forever young: Senescent cells and secret to stopping ageing

Live better for longer

In the last couple of decades, the science of anti-ageing has moved from science-fiction into academically rigorous, evidence-based, peer-reviewed science. It's not about achieving immortality, having your brain cryogenically preserved or any of the other outlandish propositions that have been mooted.

"There are a lot of people out there who sell you snake oil and tell you that you'll live forever, and then when you die, nobody sues them," says Dr Nir Barzilai, director of the Institute for Ageing at the Albert Einstein College of Medicine in New York. Instead, it's about improving what scientists call the 'healthspan', or the number of years that people can live well without disease. Extending the lifespan could be a fortuitous side effect, as could the ramifications for the economy.

Currently, 80 per cent of the world's adults aged 65 or over have at least one chronic illness, while 68 per cent have two or more. The human suffering is huge, and in the next 30 years, the number of over-65-year-olds is projected to double to 1.5 billion. This will be costly.

"If we had a drug that adds even one or two healthy years onto the lifespan, it would have trillions of dollars of effect on the world economy, because people would be productive for longer and they wouldn't have all these morbidities that cost our healthcare systems so much," says Jim Mellon, chairman of the longevity company Juvenescence.

Staving off physical and mental decline is vital if we're expected to live longer © Getty Images

It's no coincidence that age is the biggest risk factor for illnesses such as cancer, cardiovascular disease and neurodegeneration. The ageing process involves a whole raft of biological changes that drives their development. Scientists call these changes 'hallmarks' and around nine have been identified, including the accumulation of genetic mutations, the unravelling of chromosomes and the impaired ability of tiny cellular power packs, called mitochondria, to function.

According to the theory, if you can correct these problems, you won't just slow down ageing, you'll also prevent or defer many of the diseases that are associated with old age.

In December 2021, researchers from the University of the Chinese Academy of Sciences in Shanghai revealed that a natural compound found in grape seeds could prolong the lifespan of old mice by 9 per cent, and make them physically fitter too. The compound, called procyanidin C1, works by targeting another of the hallmarks of ageing: the build-up of tired, worn-out cells that are described as 'senescent'.

In our younger years, the immune system clears senescent cells from the body before they can cause a problem, but as we age and our immune system falters, the cells get to hang around, secreting inflammatory molecules that injure the surrounding tissue.

"It's like a fire that spreads," says Ming Xu, who studies senescence at the University of Connecticut's Centre on Ageing.

"It's a very small population of cells, but they have a very large and very damaging effect." Drugs that seek out and kill these senescent cells, known as senolytics, are among the most promising anti-ageing therapies.

Xu and colleagues have shown that when small numbers of senescent cells are transplanted into mice, it ages them. Then when the same mice are treated, not with procyanidin C1, but with a cocktail of two different senolytic drugs, the rogue cells are destroyed and the mice become more robust. They develop stronger muscles, become more active and live longer. The same results are seen in mice that have aged naturally.

The ability of our mitochondria, essentially the batteries of our cells, declines as we age © Getty Images

It's all the more impressive because the mice received the drugs very late in life, when they were already two years old. "It's the equivalent of a person beginning treatment when they are 70 or 80, and then having their healthy lifespan extended by five to six years," says Xu.

Also encouraging is the fact that these drugs are already known to be safe for human use. Quercetin, which is a plant pigment found in many fruits and vegetables, is sold as a dietary supplement, while dasatinib is approved for use as a blood cancer drug.

Further animal studies have shown that senolytic drugs can delay, prevent or ease more than 40 diseases, including cancers and various disorders of the heart, liver, kidney, lung, eye and brain. Preliminary studies in humans show that they reduce the number of senescent cells, curb inflammation and alleviate frailty, and now dozens of clinical trials are underway to assess their impact on various conditions, including diabetes, arthritis and Alzheimer's disease.

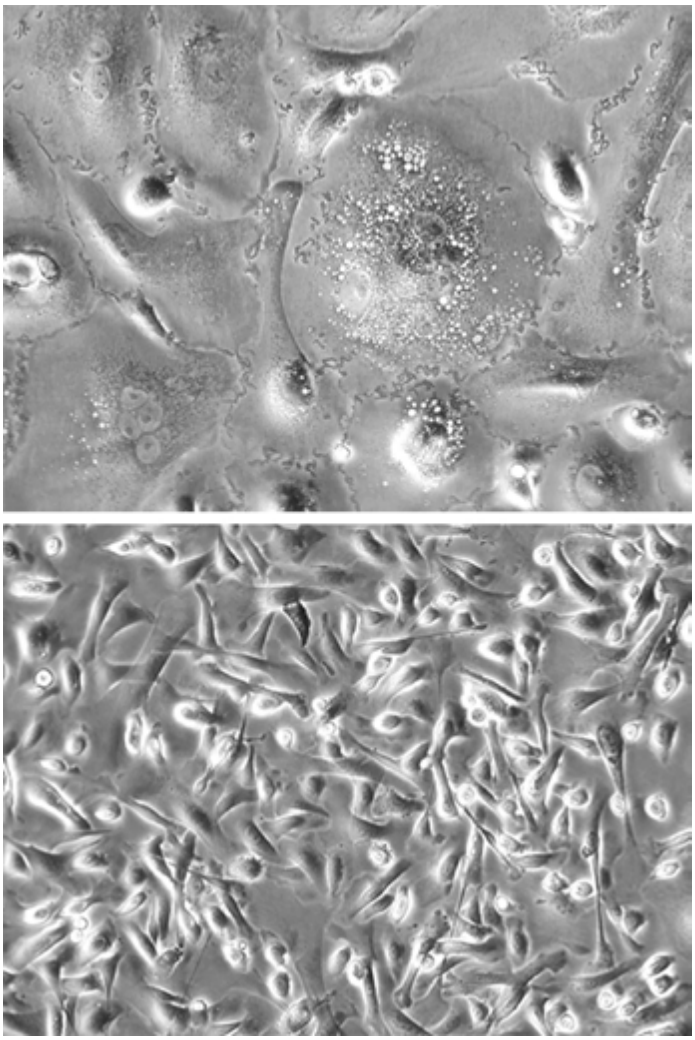
All of these trials will yield vital information, but if a senolytic or any other drug is ever to be used as a genuine anti-ageing therapy, it'll need to pass muster in the human equivalent of Xu's mouse study. As well as testing these drugs in people who already have disease – as is happening in the current clinical trials – they also need to be rigorously tested in healthy people who are ageing naturally.

Speeding up a slow process

It's a conceptual no-brainer and should be straightforward, save for a couple of problems. The first is that humans take decades to age, a predicament that makes the requisite trials both lengthy and expensive.

One potential solution to this problem, currently under investigation, is to use molecular proxies or 'biomarkers' of the ageing process. These are subtle changes, such as the addition of certain chemical groups to DNA, that occur across smaller time frames and are thought to be indicative of the broader ageing picture.

Another option is to turn to man's best friend. Dogs age around seven times faster than humans, and experience many of the same age-related diseases and declines. They also share our homes and many of the same environmental influences that contribute to ageing. In short, they're an excellent model of the ageing process, and are willing to help out in exchange for treats and belly rubs.



The different proliferations of keratinocytes, a type of skin cell, in an old mouse (top) and a young mouse (bottom) © Birgit Ritschka/Research Institute of Molecular Pathology Vienna

As part of the Dog Aging Project in the US, 500 canines are helping to assess the worth of another putative anti-ageing treatment, called rapamycin. Rapamycin also targets senescent cells, as well as several of the other hallmarks of ageing.

Relatively large doses are given to transplant patients to help prevent organ rejection, but in small doses it's been shown to prolong life in yeast, worms, flies and mice. The dogs will be followed for up to a decade and if rapamycin's promise holds true, those who receive the therapy could have their lives extended by up to four human years (or 28 dog years).

The second problem with arranging the requisite human studies is less practical and more attitudinal. According to the current medical paradigm, ageing is not something that needs to be treated. Along with hangovers and nuisance phone calls, ageing is viewed as a grim inevitability of life.

If the US Food and Drug Administration (FDA) and other medical regulators are ever to approve a drug for ageing, they would first need to recognise that ageing is a preventable condition that can be targeted therapeutically. "We don't want to call ageing a disease," says Barzilai. "The people we want to help don't want us to call them sick, but ageing does need to be officially recognised as an 'indication' that is treatable."

So Barzilai has found a way around the conundrum. His focus is on another potential anti-ageing drug, called metformin. Metformin is a cheap and successful medicine. Every day, millions of people take it to control their type 2 diabetes, but in 2016, Barzilai suggested it could be used to slow ageing.

Dogs age in similar ways to humans but considerably faster, so are useful proxies © Shutterstock

Key to his argument is a 2014 UK clinical trial involving over 150,000 people, which revealed that diabetics taking metformin live longer than non-diabetics who don't, and a growing number of separate studies that demonstrate metformin's ability to prevent specific age-related disorders. Taken together, these studies hint that metformin may be able to improve the healthspan, but they don't quite nail it. What's needed is a clinical trial that ties all these loose ends together in a single, well-designed study. Enter, the 'Targeting Aging with Metformin' (TAME) trial.

Barzilai and colleagues are recruiting 3,000 adults, aged 65 to 80, who don't have diabetes, to receive either metformin or a placebo over a four-year period. During this time, the team will monitor age-related biomarkers and the time it takes for each of the patients to develop a major age-related disease, such as dementia or stroke.

Instead of looking at the ability of metformin to delay a single age-related disease, as the other trials have done, this study will assess the drug's capacity to delay the onset of age-related disease in general. It will show if metformin can increase the healthspan.

If the trial succeeds, its effects could be far-reaching. TAME has the power to prove that ageing really is something that can be targeted and treated with drugs. This, in itself, will be a major paradigm shift. "We hope it will inspire the FDA to make ageing an indication and provide a template for other biotech companies to do similar studies," says Barzilai.

While other scientists pursue different anti-ageing strategies, such as gene therapy or tissue transplants, taking tablets is so much simpler. Metformin could become the first authorised anti-ageing drug with the ability to not just prolong life, but to prolong a healthy life. Then after metformin, other anti-ageing drugs could follow. Instead of treating each age-related medical condition separately, as currently happens, it's possible to imagine a future where these conditions are 'treated' together, by targeting multiple hallmarks of ageing.

Just as statins are doled out today to lower cholesterol, and prevent strokes and heart disease, so too anti-ageing medicines or 'gerotherapeutics' could be prescribed to prevent the diseases of old age. Based on the results of a blood test, which could indicate how fast you're ageing and which diseases you're prone to, a clinician might prescribe one or more anti-ageing drugs.

Dr Nir Barzilai and his team are investigating ways of increasing human healthspans © Albert Einstein College of Medicine

Metformin, rapamycin, quercetin, dasatinib and other as-yet-unidentified anti-ageing drugs could all be part of the picture. It would mark a shift away from the prevailing medical model, where diseases are treated reactively after symptoms have occurred and suffering has set in, to a preventative model of care, where patients are monitored proactively and future diseases are averted.

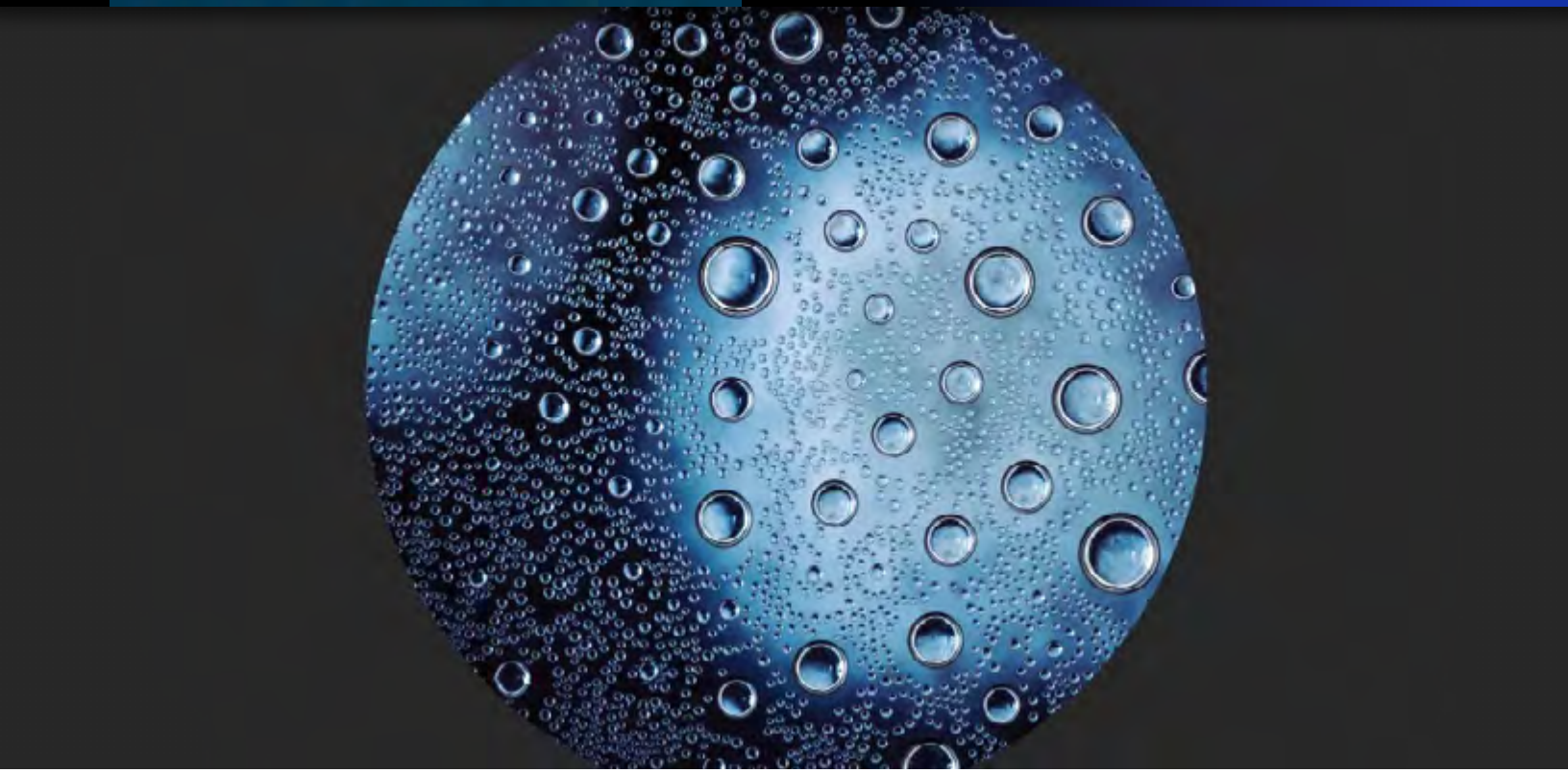
With a handful of promising anti-ageing drugs already in existence, ageing has never looked so 'treatable', and yet, there's just one final problem. Clinical trials don't come cheap, so the question is, who pays?

Government funding agencies seemingly aren't keen to invest in the anti-ageing area. Regulators don't tend to fund studies of drugs that are already on the market, and the pharmaceutical industry won't cough up for trials of drugs that are generic, cheap or off-patent, with no profit margin.

The 30 or so bona fide anti-ageing companies that exist are more interested in developing their own proprietary therapies than readily accessible drugs such as metformin or quercetin. Until additional funding can be found, this means that safe, affordable drugs with the potential to slow ageing and extend the healthspan are not being properly explored. Meanwhile, the people who need them most are growing old waiting.

This article first appeared in issue 373 of *BBC Science Focus Magazine* – **find out how to subscribe here**

LIVESCIENCE from LIVESCIENCE.COM



Water's ultimate freezing point just got lower

- Scientists just broke the record for water's freezing point.

By Ashley Hamer published December 10, 2021

"Ice cold" just got even colder: By creating ice from tiny droplets only a few hundred molecules in size, researchers have pushed water's freezing point lower than ever before and changed what we know about how ice forms.

Knowing how and why water transforms into ice is essential for understanding a wide range of natural processes. Climate fluctuations, cloud dynamics and the water cycle are all influenced by water-ice transformations, as are animals that live in freezing conditions.

Wood frogs, for example, survive the winter on land by allowing their bodies to freeze. This allows them to come out of hibernation faster than species that spend the winter deep underwater without freezing. But ice crystals can rupture cell membranes, so animals that use this technique need to find a way to prevent ice from forming in their cells and tissues. A better understanding of how water freezes could lead to a better understanding of these extreme species.

While the rule of thumb is that water freezes at 32 degrees Fahrenheit (0 degrees Celsius), water can actually stay liquid over a range of chilly temperatures under certain conditions. Until now, it was believed that this range stopped at minus 36 F (minus 38 C); any lower than that, and water must freeze. But in a study published Nov. 30 in the journal Nature Communications, researchers managed to keep droplets of water in a liquid state at temperatures as low as minus 47.2 F (minus 44 C).

There were two keys to their breakthrough: very small droplets and a very soft surface. They began with droplets ranging from 150 nanometers, barely bigger than an influenza virus particle, to as small as 2 nanometers, a cluster of only 275 water molecules. This range of droplet sizes helped the researchers uncover the role of size in the transformation from water to ice.

"We covered all of these ranges so that we can understand at which condition ice is going to form — which temperature, which size of the droplets," study co-author Hadi Ghasemi, a mechanical engineering professor at the University of Houston, told Live Science. "And more importantly, we found that if the water droplets are covered with some soft materials, the freezing temperature can be suppressed to a really low temperature."

The soft material they used was octane, an oil that surrounded each droplet within the nanoscale pores of an anodized aluminum oxide membrane. That allowed the droplets to take on a more rounded shape with greater pressure, which the researchers say is essential for preventing ice formation at these low temperatures.

Because it's basically impossible to observe the freezing process at these small scales, the researchers used measures of electrical conductance — since ice is more conductive than water — and light emitted in the infrared spectrum to catch the exact moment and temperature at which the droplets transformed from water to ice.

They found that the smaller the droplet, the colder it had to be for ice to form — and for droplets that were 10 nanometers and smaller, the rate of ice formation dropped dramatically. In the smallest droplets they measured, ice didn't form until the water had reached a bone-chilling minus 44 C.

Does this mean that the microscopic droplets within clouds and biological cells can get even colder than we thought? "As a scientist, I would say we don't know yet," Ghasemi said.

But this discovery could mean big things for ice prevention on human-made materials, like those in aviation and energy systems, Ghasemi said. If water on soft surfaces takes longer to freeze, engineers could incorporate a mix of soft and hard materials into their designs to keep ice from building up on those surfaces.

"There are so many ways that you can use this knowledge to design the surfaces to avoid ice formation," Ghasemi said. "Once we have this fundamental understanding, that next step is just the engineering of these surfaces based on the soft materials."

Originally published on Live Science.

PHYS.ORG

from PHYS.ORG

Imaging breakthrough could aid development of quantum microscopes

by University of Glasgow

A breakthrough in quantum imaging could lead to the development of advanced forms of microscopy for use in medical research and diagnostics.

A team of physicists from the University of Glasgow and Heriot-Watt University have found a new way to create detailed microscopic images under conditions which would cause conventional optical microscopes to fail.

In a new paper published today in the journal Nature Photonics, the team describe how they have generated images by finding a new way to harness a quantum phenomenon known as Hong-Ou-Mandel (HOM) interference.

Named after the three researchers who first demonstrated it in 1987, HOM interference occurs when quantum-entangled photons are passed through a beam splitter—a glass prism which can turn a single beam of light into two separate beams as it passes through. Inside the prism, the photons can either be reflected internally or transmitted outwards.

When the photons are identical, they will always exit the splitter in the same direction, a process known as 'bunching'. When the entangled photons are measured using photodetectors at the end of the path of the split beam of light, a characteristic 'dip' in the output probability graph of the light shows that the bunched photons are reaching only one detector and not the other.

That dip is the Hong-Ou-Mandel effect, which demonstrates the perfect entanglement of two photons. It has been put to use in applications like logic gates in quantum computers, which require perfect entanglement in order to work.

It has also been used in quantum sensing by putting a transparent surface between one output of the beam splitter and the photodetector, introducing a very slight delay into the time it takes for photons to be detected. Sophisticated analysis of the delay can help reconstruct details like the thickness of surfaces.

Detailed microscopic image of UofG sign. Credit: Professor Daniele Faccio

Now, the Glasgow-led team has applied it to microscopy, using single-photon sensitive cameras to measure the bunched and anti-bunched photons and resolve microscopic images of surfaces.

In the Nature Photonics paper, they show how they have used their setup to create high-resolution images of some clear acrylic sprayed onto a microscope slide with an aver-

age depth of 13 microns and a set of letters spelling 'UofG' etched onto a piece of glass at around 8 microns deep.

Their results demonstrate that it is possible to create detailed, low-noise images of surfaces with a resolution of between one and 10 microns, producing results close to that of a conventional microscope.

Professor Daniele Faccio, of the University of Glasgow's School of Physics and Astronomy, is the paper's lead author. Professor Faccio said: "Conventional microscopy using visible light has taught us a vast amount about the natural world and helped us make an incredible array of technological advances.

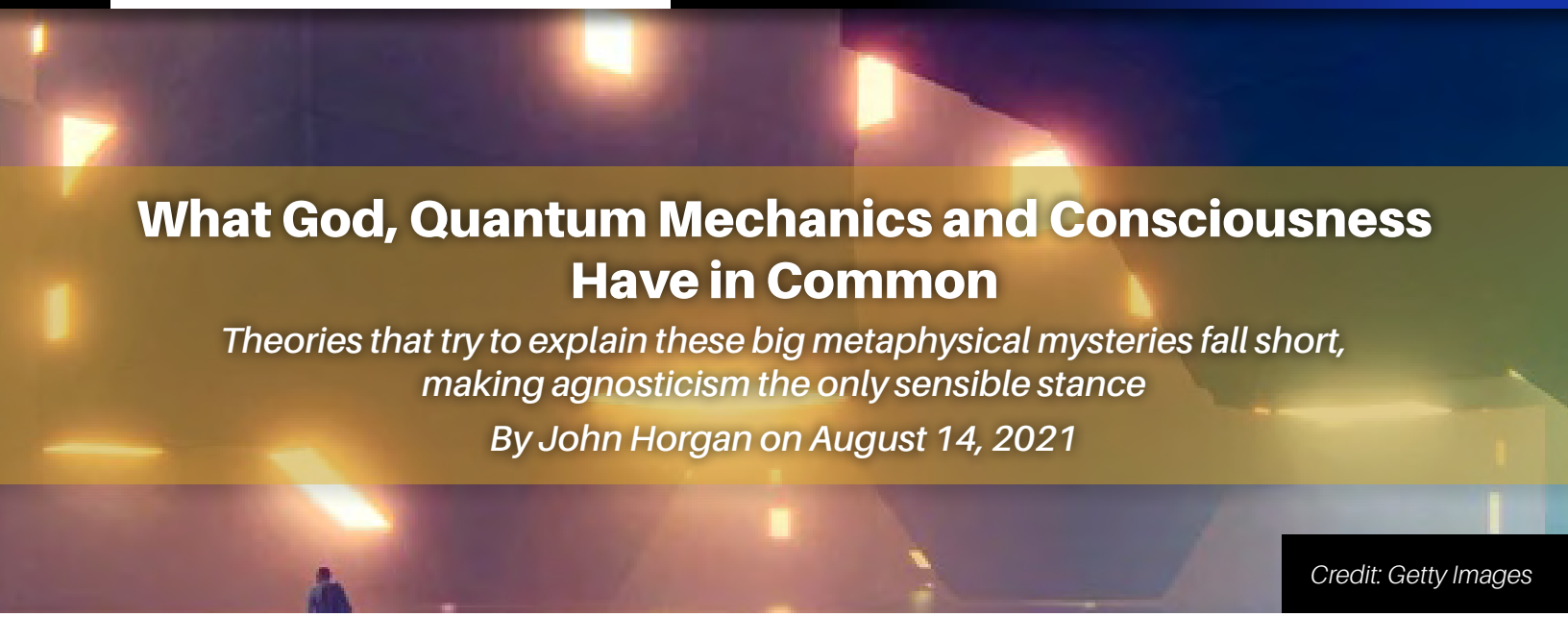
"However, it does have some limitations which can be overcome by using quantum light to probe the microscopic realm. In bioimaging, where cells can be almost entirely transparent, being able to examine their fine details without using conventional light could be a major advantage—we chose to image transparent surfaces in this research precisely to demonstrate that potential.

"Similarly, samples in conventional microscopes need to be kept perfectly still—introducing even a small vibration could introduce a level of blur which would ruin an image. However, HOM interference requires only measuring photon correlations and there is much less need for stability.

"Now that we've established that it's possible to build this kind of quantum microscopy by harnessing the Hong-Ou-Mandel effect, we're keen to improve the technique to make it possible to resolve nanoscale images. It will require some clever engineering to achieve, but the prospect of being able to clearly see extremely small features like cell membranes or even strands of DNA is an exciting one. We're looking forward to continuing to refine our design."

SCIENTIFIC AMERICAN.

from SCIENTIFICAMERICAN.COM



What God, Quantum Mechanics and Consciousness Have in Common

Theories that try to explain these big metaphysical mysteries fall short, making agnosticism the only sensible stance

By John Horgan on August 14, 2021

Credit: Getty Images

In my 20s, I had a friend who was brilliant, charming, Ivy-educated and rich, heir to a family fortune. I'll call him Gallagher. He could do anything he wanted. He experimented, dabbling in neuroscience, law, philosophy and other fields. But he was so critical, so picky, that he never settled on a career. Nothing was good enough for him. He never found love for the same reason. He also disparaged his friends' choices, so much so that he alienated us. He ended up bitter and alone. At least that's my guess. I haven't spoken to Gallagher in decades.

There is such a thing as being too picky, especially when it comes to things like work, love and nourishment (even the pickiest eater has to eat something). That's the lesson I gleaned from Gallagher. But when it comes to answers to big mysteries, most of us aren't picky enough. We settle on answers for bad reasons, for example, because our parents, priests or professors believe it. We think we need to believe

something, but actually we don't. We can, and should, decide that no answers are good enough. We should be agnostics.

Some people confuse agnosticism (not knowing) with apathy (not caring). Take Francis Collins, a geneticist who directs the National Institutes of Health. He is a devout Christian, who believes that Jesus performed miracles, died for our sins and rose from the dead. In his 2006 bestseller The Language of God, Collins calls agnosticism a "cop-out." When I interviewed him, I told him I am an agnostic and objected to "cop-out."

Collins apologized. "That was a put-down that should not apply to earnest agnostics who have considered the evidence and still don't find an answer," he said. "I was reacting to the agnosticism I see in the scientific community, which has not been arrived at by a careful examination of the evidence." I have examined the evidence for Christianity, and I find it unconvincing. I'm not convinced by any scientific creation stories, either, such as those that depict our cosmos as a bubble in an oceanic "multiverse."

People I admire fault me for being too skeptical. One is the late religious philosopher Huston Smith, who called me "convictionally impaired." Another is megapundit Robert Wright, an old friend, with whom I've often argued about evolutionary psychology and Buddhism. Wright once asked me in exasperation, "Don't you believe anything?" Actually, I believe lots of things, for example, that war is bad and should be abolished.

But when it comes to theories about ultimate reality, I'm with Voltaire. "Doubt is not a pleasant condition," Voltaire said, "but certainty is an absurd one." Doubt protects us from dogmatism, which can easily morph into fanaticism and what William James calls a "premature closing of our accounts with reality." Below I defend agnosticism as a stance toward the existence of God, interpretations of quantum mechanics and theories of consciousness. When considering alleged answers to these three riddles, we should be as picky as my old friend Gallagher.

THE PROBLEM OF EVIL

Why do we exist? The answer, according to the major monotheistic religions, including the Catholic faith in which I was raised, is that an all-powerful, supernatural entity created us. This deity loves us, as a human father loves his children, and wants us to behave in a certain way. If we're good, He'll reward us. If we're bad, He'll punish us. (I use the pronoun "He" because most scriptures describe God as male.)

My main objection to this explanation of reality is the problem of evil. A casual glance at human history, and at the world today, reveals enormous suffering and injustice. If God loves us and is omnipotent, why is life so horrific for so many people? A standard response to this question is that God gave us free will; we can choose to be bad as well as good.

The late, great physicist Steven Weinberg, an atheist, who died in July, slaps down the free will argument in his book Dreams of a Final Theory. Noting that Nazis killed many of his relatives in the Holocaust, Weinberg asks: Did millions of Jews have to die so the Nazis could exercise their free will? That doesn't seem fair. And what about kids who get cancer? Are we supposed to think that cancer cells have free will?

On the other hand, life isn't always hellish. We experience love, friendship, adventure and heartbreaking beauty. Could all this really come from random collisions of particles? Even Weinberg concedes that life sometimes seems "more beautiful than strictly necessary." If the problem of evil prevents me from believing in a loving God, then the problem of beauty keeps me from being an atheist like Weinberg. Hence, agnosticism.

THE PROBLEM OF INFORMATION

Quantum mechanics is science's most precise, powerful theory of reality. It has predicted countless experiments, spawned countless applications. The trouble is, physicists and philosophers disagree over what it means, that is, what it says about how the world works. Many physicists—most, probably—adhere to the Copenhagen interpretation, advanced by Danish physicist Niels Bohr. But that is a kind of anti-interpretation, which says physicists should not try to make sense of quantum mechanics; they should "shut up and calculate," as physicist David Mermin once put it.

Philosopher Tim Maudlin deplores this situation. In his 2019 book Philosophy of Physics: Quantum Theory, he points out that several interpretations of quantum mechanics describe in detail how the world works. These include the GRW model proposed by Ghirardi, Rimini and Weber; the pilot-wave theory of David Bohm; and the many-worlds hypothesis of Hugh Everett. But here's the irony: Maudlin is so scrupulous in pointing out the flaws of these interpretations that he reinforces my skepticism. They all seem hopelessly kludgy and preposterous.

Maudlin does not examine interpretations that recast quantum mechanics as a theory about information. For positive perspectives on information-based interpretations, check out Beyond Weird by journalist Philip Ball and The Ascent of Information by astrobiologist Caleb Scharf. But to my mind, information-based takes on quantum mechanics are even less plausible than the interpretations that Maudlin scrutinizes. The concept of information makes no sense without conscious beings to send, receive and act upon the information.

Introducing consciousness into physics undermines its

claim to objectivity. Moreover, as far as we know, consciousness arises only in certain organisms that have existed for a brief period here on Earth. So how can quantum mechanics, if it's a theory of information rather than matter and energy, apply to the entire cosmos since the big bang? Information-based theories of physics seem like a throwback to geocentrism, which assumed the universe revolves around us. Given the problems with all interpretations of quantum mechanics, agnosticism, again, strikes me as a sensible stance.

MIND-BODY PROBLEMS

The debate over consciousness is even more fractious than the debate over quantum mechanics. How does matter make a mind? A few decades ago, a consensus seemed to be emerging. Philosopher Daniel Dennett, in his cockily titled Consciousness Explained, asserted that consciousness clearly emerges from neural processes, such as electrochemical pulses in the brain. Francis Crick and Christof Koch proposed that consciousness is generated by networks of neurons oscillating in synchrony.

Gradually, this consensus collapsed, as empirical evidence for neural theories of consciousness failed to materialize. As I point out in my recent book Mind-Body Problems, there are now a dizzying variety of theories of consciousness. Christof Koch has thrown his weight behind integrated information theory, which holds that consciousness might be a property of all matter, not just brains. This theory suffers from the same problems as information-based theories of quantum mechanics. Theorists such as Roger Penrose, who won last year's Nobel Prize in Physics, have conjectured that quantum effects underpin consciousness, but this theory is even more lacking in evidence than integrated information theory.

Researchers cannot even agree on what form a theory of consciousness should take. Should it be a philosophical treatise? A purely mathematical model? A gigantic algorithm, perhaps based on Bayesian computation? Should it borrow concepts from Buddhism, such as anatta, the doctrine of no self? All of the above? None of the above? Consensus seems farther away than ever. And that's a good thing. We should be open-minded about our minds.

So, what's the difference, if any, between me and Gallagher, my former friend? I like to think it's a matter of style. Gallagher scorned the choices of others. He resembled one of those mean-spirited atheists who revile the faithful for their beliefs. I try not to be dogmatic in my disbelief, and to be sympathetic toward those who, like Francis Collins, have found answers that work for them. Also, I get a kick out of inventive theories of everything, such as John Wheeler's "it from bit" and Freeman Dyson's principle of maximum diversity, even if I can't embrace them.

I'm definitely a skeptic. I doubt we'll ever know whether God exists, what quantum mechanics means, how matter makes mind. These three puzzles, I suspect, are different aspects of a single, impenetrable mystery at the heart of things. But one of the pleasures of agnosticism—perhaps the greatest pleasure—is that I can keep looking for answers and hoping that a revelation awaits just over the horizon

Science Focus
THE HOME OF BBC SCIENCE FOCUS MAGAZINE
from SCIENCEFOCUS.COM

In pictures: The air taxis that could be taking to the skies by 2025

By Ian TaylorPublished: 19th March, 2022 at 16:00

You could be hailing an air taxi sooner than you'd expect.

Fancy flying to the office? It could be on the cards sooner than you think, given how many air taxis are currently in development.

From well-known aviation experts like Airbus and Boeing to specialist manufacturers like Vertical Aerospace, flying cars are being developed around the world.

Take a look at the prototype vehicles that could be shuttling you around the country at 200mph by the end of the decade.

Flying cars take off: How air taxis are about to revolutionise how we travel

Airbus

Airbus unveiled the NextGen version of its CityAirbus air taxi in 2021. Although still on the drawing board, a prototype is due to begin tested in 2023 © Airbus

VoloCity

The VoloCity air taxi, seen here taking a demo flight over Singapore's Marina Bay in 2019, bore only a passing resemblance to the prototype that first flew in 2011 © Getty Images

Boeing

Boeing's Passenger Air Vehicle (PAV) is an autonomous air taxi with a configuration that differs from the 'norm', relying on propellers that are not positioned on the wings © Boeing

Joby Aviation

The Joby aircraft is expected to gain its air carrier certification from the Federal Aviation Administration in the US in 2022, and there are plans for it to be in service as an aerial ride-share service by 2024 © Joby Aviation

Hoversurf

2021 saw the Russian company Hoversurf testing a prototype of the vehicle it hopes to develop into a drone air taxi © AFP

Vertical Aerospace

An artist's impression showing Vertical's VA-X4 vehicle waiting for its next fare on top of a city-centre skyscraper © Vertical Aerospace

from SCITECHDAILY.COM

MIT Researchers Propose a New Way To Create Synthesizable Molecules

By LAUREN HINKEL, MASSACHUSETTS INSTITUTE OF TECHNOLOGY APRIL 7, 2022

MIT and IBM researchers have use a generative model with a graph grammar to create new molecules belonging to the same class of compound as the training set.

An efficient machine-learning method uses chemical knowledge to create a learnable grammar with production rules to build synthesizable monomers and polymers.

Chemical engineers and materials scientists are constantly looking for the next revolutionary material, chemical, and drug. The rise of machine-learning approaches is expediting the discovery process, which could otherwise take years. "Ideally, the goal is to train a machine-learning model on a few existing chemical samples and then allow it to produce as many manufacturable molecules of the same class as possible, with predictable physical properties," says Wojciech Matusik, professor of electrical engineering and computer science at MIT. "If you have all these components, you can build new molecules with optimal properties, and you also know how to synthesize them. That's the overall vision that people in that space want to achieve"

However, current techniques, mainly deep learning, require extensive datasets for training models, and many class-specific chemical datasets contain a handful of example compounds, limiting their ability to generalize and generate physical molecules that could be created in the real world.

Now, a new paper from researchers at MIT and IBM tackles this problem using a generative graph model to build new

synthesizable molecules within the same chemical class as their training data. To do this, they treat the formation of atoms and chemical bonds as a graph and develop a graph grammar — a linguistics analogy of systems and structures for word ordering — that contains a sequence of rules for building molecules, such as monomers and polymers. Using the grammar and production rules that were inferred from the training set, the model can not only reverse engineer its examples, but can create new compounds in a systematic and data-efficient way. "We basically built a language for creating molecules," says Matusik "This grammar essentially is the generative model."

Matusik's co-authors include MIT graduate students Minghao Guo, who is the lead author, and Beichen Li as well as Veronika Thost, Payal Das, and Jie Chen, research staff members with IBM Research. Matusik, Thost, and Chen are affiliated with the MIT-IBM Watson AI Lab. Their method, which they've called data-efficient graph grammar (DEG), will be presented at the International Conference on Learning Representations.

"We want to use this grammar representation for monomer and polymer generation, because this grammar is explainable and expressive," says Guo. "With only a few number of the production rules, we can generate many kinds of structures."

A molecular structure can be thought of as a symbolic representation in a graph — a string of atoms (nodes) joined together by chemical bonds (edges). In this method, the researchers allow the model to take the chemical structure and collapse a substructure of the molecule down to one node; this may be two atoms connected by a bond, a short sequence of bonded atoms, or a ring of atoms. This is done repeatedly, creating the production rules as it goes, until a single node remains. The rules and grammar then could be applied in the reverse order to recreate the training set from scratch or combined in different combinations to produce new molecules of the same chemical class.

"Existing graph generation methods would produce one node or one edge sequentially at a time, but we are looking at higher-level structures and, specifically, exploiting chemistry knowledge, so that we don't treat the individual atoms and bonds as the unit. This simplifies the generation process and also makes it more data-efficient to learn," says Chen.

Further, the researchers optimized the technique so that the bottom-up grammar was relatively simple and straightforward, such that it fabricated molecules that could be made.

"If we switch the order of applying these production rules, we would get another molecule; what's more, we can enumerate all the possibilities and generate tons of them," says Chen. "Some of these molecules are valid and some of them not, so the learning of the grammar itself is actually to figure out a minimal collection of production rules, such that the percentage of molecules that can actually be synthesized is maximized." While the researchers concentrated on three training sets of less than 33 samples each — acrylates, chain extenders, and isocyanates — they note that the process could be applied to any chemical class.

To see how their method performed, the researchers tested DEG against other state-of-the-art models and techniques, looking at percentages of chemically valid and unique molecules, diversity of those created, success rate of retrosynthesis, and percentage of molecules belonging to the training data's monomer class.

"We clearly show that, for the synthesizability and membership, our algorithm outperforms all the existing methods by a very large margin, while it's comparable for some other widely-used metrics," says Guo. Further, "what is amazing about our algorithm is that we only need about 0.15 percent of the original dataset to achieve very similar results compared to state-of-the-art approaches that train on tens of thousands of samples. Our algorithm can specifically handle the problem of data sparsity."

In the immediate future, the team plans to address scaling up this grammar learning process to be able to generate large graphs, as well as produce and identify chemicals with desired properties.

Down the road, the researchers see many applications for the DEG method, as it's adaptable beyond generating new chemical structures, the team points out. A graph is a very flexible representation, and many entities can be symbolized in this form — robots, vehicles, buildings, and electronic circuits, for example. "Essentially, our goal is to build up our grammar, so that our graphic representation can be widely used across many different domains," says Guo, as "DEG can automate the design of novel entities and structures," says Chen.

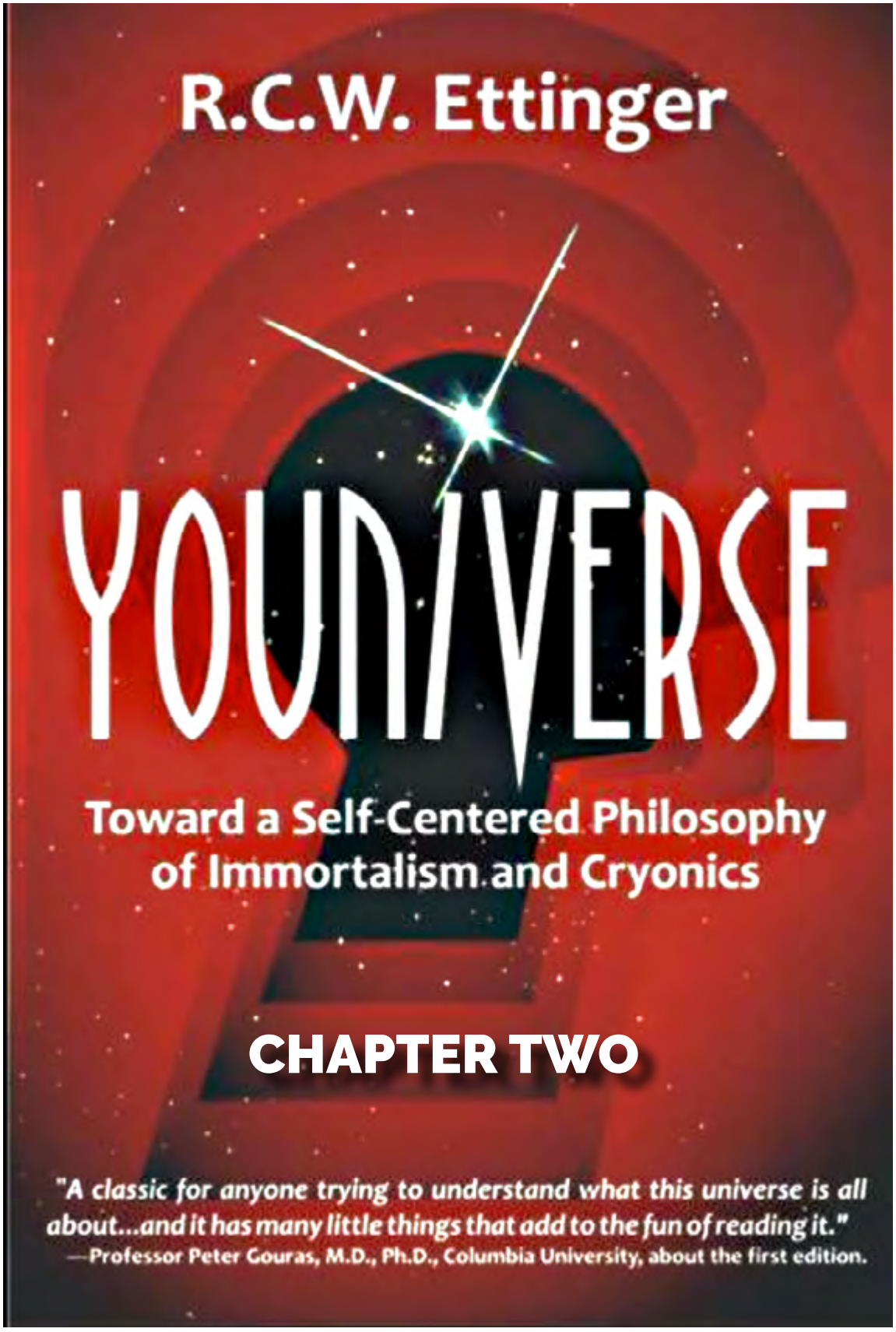
Reference: "Data-Efficient Graph Grammar Learning for Molecular Generation" by Minghao Guo, Veronika Thost, Beichen Li, Payel Das, Jie Chen and Wojciech Matusik, 28 September 2021, ICLR 2022 Conference.

OpenReview

This research was supported, in part, by the MIT-IBM Watson AI Lab and Evonik.

CI Reading Room

Serializing essential works on cryonics



Chapter 3

Science As Savior

Your Life is at Stake, and your Happiness.

This is my excuse for asking you to question your indoctrination and attempt to make rational choices based on your enlightened self-interest.

Is it too much to ask that you weigh evidence and make rational choices in your personal life? Yes, it is too much in most cases and most of the time. Very few have the inclination or training to evaluate alternatives quantitatively, and even fewer are willing to examine their assumptions and traditions, or even acknowledge that these are open to question. But once again, if we can't do everything, we can still do something. Some percentage of readers, in some areas of their lives, may be willing to take another look and consider the potential of their future lives. Now, some generalities about the scientific approach to life.

Science is Flourishing as Never Before —Yet, so is Superstition!

("Superstition" in my lexicon includes traditional religion as well as less popular cults and nominally godless ideologies such as communism and humanism.)

Intellectual chic finds science oversold and empty of salvation. We are told (even by many scientists) that technology has only means and no ends, that ultimate answers can be found or generated only in the soul and not the brain, that the world of matter and of the spirit are separate and the latter cannot be explored through gadgetry.

Some of the brightest and best believe this drivel —as do almost all of those who are not so bright. Yet it is just a tiresome misunderstanding based mainly on carelessness with words.

Some great minds have tried to define what is meant by *science*. Einstein took a clumsy crack at it, and many others. Lord Kelvin may have some closest to the prevalent feeling when he said some-thing like this: "When you can measure something, then you are dealing in science. If you cannot ask and answer quantitative questions, you have not yet advanced to the stage of science."

Others have tried to lay out a specific procedure for a scientific enterprise—maybe something like first form an hypothesis, then test the hypothesis, then devise a quantitative theory and test that, etc. The problem is that real scientists seldom follow such rules.

How to straighten yourself out? How to be scientific without memorizing a set of rigid rules? Percy Bridgman (Harvard professor, physicist and philosopher) put it something like this: "Science is just doing your utmost with your mind, no holds barred."

That's more like it. Karl Popper is in the same camp. In *All Life Is Problem Solving* (Routledge, 1999), he writes that he is one of those who love science and who think that science is enlightened common sense. He also reminds as engagingly that "progress" is not necessarily a one-way street, and that we, along with other animals, have forgotten that

sunlight is edible, and how to eat it Maybe the "bush man" of the future will give new meaning to "green thumb".

I like to say that science is not a procedure, but an attitude, and its essentials are honesty and resourcefulness. The latter of course includes curiosity and a tendency to *skepticism*.

Facing Facts & Questioning "Facts":

Much of what you have been taught is wrong. In 1637, Dryden wrote The Hind and the Panther, including this:

By education most have been misled; So they believe, because they were so bred. The priest continues what the nurse began: And thus the child imposes on the man.

We must be willing to face the facts, and we most also be willing to review or question 'Tarts" that are alleged or entrenched in belief when an occasion for doubt arises. Neither is easy—indeed, next to impossible for the average person.

To be sure, many scientists would like to include more detail in the guidelines. For example, it is important in experimental science to have results repeated, and also verified by independent investigators. Such habits are often helpful, but they don't change the essence.

My definition, or Bridgman's, might be said to have the drawback of not distinguishing between scientists and laymen, or between scientists and engineers, etc. That's true, but it's common enough to operate on different levels and use words in different ways in different situations. The present discussion is about science as savior, the proposition that your best chance in life is through ruthless honesty and determined effort.

It's not a matter of lab coats, or test tubes, or titles, or degrees, but just the ability and willingness to deal with reality and not flinch, not kid yourself or others. The scientific attitude—and *only* that—is in this sense appropriate for *all* areas of life and thought. Nothing is excepted—not art, not literature, not politics, not religion, not playtime, not love, not anything at all.

Caution on "Authority":

Hardly anybody—even me—can resist the temptation to quote "authority" or "experts" when their opinion agrees with ours. Well, here's a reminder that even issues now deemed beyond debate, at one time had prestigious and honest defenders on both sides.

Surely the issue of human slavery cannot now be considered arguable. To condone it, let alone practice it, is just plain wrong and heinous. Yet at the time of the Civil War, there were plenty in the Confederacy who were just as smart and just as well intentioned as the abolitionists in the Union, and who offered sincere and seemingly reasonable arguments that slavery was good for the community and even for the slaves. 'Nuff said.

Sea Legs:

Individually and collectively we are on a journey, which might be likened to stumbling through a swamp or sailing over a vast and turbulent sea, with storms and fog and shoals and monsters dimly seen. Science can provide a map and compass of sorts, but of only sometime and doubtful reliability. Karl Popper's Second Thesis holds that our ignorance is sobering and bound-less. With each step forward, we not only discover new and unsolved

problems, but we also discover that where we believed that we were standing on firm and safe ground, all things are, in truth, insecure and in a state of flux.

Can we be blamed if we get seasick, or take to drink, or try to stay moored in a known and seemingly safe port? But it isn't a question of blame, and the "safety" of the port is illusory. Like it or not, we are sailors all, and we had better find our sea legs, learn to walk on pitching decks and descry the dim and distant shapes as best we can.

Doing Nothing can be Seienlifie, Too:

The difficulty of application of the scientific at-titude varies tremendously. In many cases, you properly don't give it a thought, but just do your habitual stuff, like playing with the kids. No effort, no fuss, no measurements or reports; you are just applying your common sense based on solid experience, enjoying yourself and building the future.

Sure, some kinds of play are more beneficial to children and parents than others, but we remember, "If it ain't broke, don't fix it." Limitations of time and competence *compel* us to treat *most* situations on the basis of habit and experience—nothing unscientific about that The "unscientific" part would rear its head if things went wrong and you didn't take measures. Well, a lot of things are going wrong—you are dying of old age, as the pre-mier example—and radical measures are required.

So, the realm of science has no inner bounds and no outer bounds; it includes you and the universe. Science will provide you map and compass—not necessarily the kind you might hope for, but the best available. Science will save you—not from all your fears or all the menaces, but from some use-less and shameful decisions. Science, mixed with sweat, will provide a mortar for your sanity.

Again, you don't have to wear a white coat or sport a sheepskin on the wall; but whoever is not a scientist is necessarily a fool (even if, in some temporary cases, a *happy* fool). Ill prove it to you. First we have to deal with sophomore-level clarifications in science and philosophy.

Traps of "Science':

Human ingenuity has found many ways to abuse the notion of "science."

Mary Baker Eddy's "Christian Science" is claimed to deserve that label because it is "exact" in premise and conclusion. It isn't science, and most Christians would say it isn't Christian either.

The late L Ron Hubbard's "science" of "dianetics" (which developed into the Church of Scientology) is based on wholly unsubstantiated premises.

The communism of Karl Marx was supposedly "scientific" but actually fostered and demanded blind faith or dogma. One of the best- known examples, aside from communism itself, is the official Stalinist doctrine of heredity of acquired traits (Lamarckian evolution—which incidentally has made a partial comeback).

On the other side of the fence we see the "science" of "creationism"—the claim by some otherwise perfectly respectable Christian scientists that there is more "science" supporting the biblical version of life's development than Darwin's.

The capitalist principles of Ayn Rand—although in many respects useful and valuable—were dressed up in spurious scientific or philosophical generalities mostly devoid of any real or verifiable meaning.

The °science" of astrology implies that, on average, you could categorize people by their character or personality traits, based on birth dates. If you believe that, just try it out some time on a sample of people—the work will be a bit tedious, but not difficult.

Of course, there are many borderline or unclear cases. After all, every department of science started, at some point, with guesswork based on small samples or hunches. Acupuncture was long regarded in the West as superstition or something based on the placebo effect, but lately seems to be getting more respect. One must always tread carefully.

But traps are found not only in claims of non-scientists that they are scientific, but often also in claims of actual scientists, both in defense of their own ideas and in attacking those of others.

The late Prof. Joseph Rhine spent many years at Duke University °proving" various alleged phenomena of ESP, Extra Sensory Perception, or Psi effects. His experimental methods and his use of statistics have been roundly criticized—but some of them could be demolished by just a little common sense. See Chapter 19.

The mildest and most numerous errors, perhaps, are found in biology and medicine. There are at least hundreds of °scientific" studies of vitamin C and the common cold, and most of them are severely flawed! They typically failed, for example, to take into account such factors as promptness of extra dosage on the first hint of cold symptom, which I have found to be critical.

So how does one make a choice or decision, if personal experience, hunches, folk belief, and "authority" are all unreliable—as indeed they are?

You grope and feel and sniff your way, and you discipline yourself to focus on the important things. The important things are to save and extend your life, and those of the people you love, and to raise your level of satisfaction as life goes on.

Next Issue:

Chapter Four: Determinism & Free Will

Worldwide Cryonics Groups

AUSTRALIA: The Cryonics Association of Australasia offers support and information for Australia & nearby countries. caalist@prix.pricom.com.au. Their Public Relations Officer is Philip Rhoades. **phil@pricom.com.au** GPO Box 3411, Sydney, NSW 2001 Australia. Phone: +6128001 6204 (office) or +61 2 99226979 (home.)

BELGIUM: Cryonics Belgium is an organisation that exists to inform interested parties and, if desired, can assist with handling the paperwork for a cryonic suspension. The website can be found at **www.cryonicsbelgium.com**. To get in touch, please send an email to **info@cryonicsbelgium.com**.

BHUTAN: Can help Cryonics Institute Members who need help for the transport & hospital explanation about the cryonics procedure to the Dr and authorities in Thimphou & Paro. Contacts : Jamyang Palden & Tenzin Rabgay / Emails : **palde002@umn.edu** or **jamgarnett@hotmail.co** Phones : Jamyang / 975-2-32-66-50 & Tenzin / 975-2-77-21-01-87

CANADA: This is a very active group that participated in Toronto's first cryopreservation. President, Christine Gaspar; Vice President, Gary Tripp. Visit them at: **http://www.cryocdn.org/**. There is a subgroup called the Toronto Local Group. Meeting dates and other conversations are held via the Yahoo group. This is a closed group. To join write: **csc5@cryocdn.org**

QUEBEC: Contact: Stephan Beauregard, C.I. Director & Official Administrator of the Cryonics Institute Facebook Page. Information about Cryonics & perfusion services in Montreal for all cryonicicts. Services available in French & English: **stephan@cryonics.org**

CHILE: Community oriented to provide reliable information on human cryopreservation, as far as technical scientific as well as other practical aspects. Dissemination, awareness and education on issues related to the extension of life in general and cryonics in particular. Contact José Luis Galdames via **galdamesh.jl@gmail.com.**

FINLAND: The Finnish Cryonics Society, (KRYOFIN) was established in 2008 and is an organization collaborating with all nearby groups and organizations. Contact them at: **kryoniikka.fi** Their President is Ville Salmensuu **ville@salmensuu.fi**

FRANCE: SOCIETE CRYONICS DE FRANCE is a non profit French organization working closely with European cryonics groups. For more information: J.Roland Missionnier: phone: 33 (0) 6 64 90 98 41 or email: **cryonicsnews.inpi@gmail.com** • **Facebook group**

Francecryonics-Webnode Vivien Gruss, member of Cryonics Institute, has opened a web site for the information of persons interested in cryonic suspension.

GERMANY: DGAB There are a number of Cryonicists in Germany. Their Organization is called "Deutsche Gesellschaft für Angewandte Biostase e.V.", or short "DGAB". More information on their homepage at **www.biostase.de**. If there are further questions, contact their Board at **vorstand@biostase.de**

GERMANY: CRYONICS-GERMANY is an active group providing cryonics support, including a special 8-member Standby Response Team. Members from Germany or Internationally are welcome to join. at **http://cryonics-germany.org**. Direct inquiries to **contact@cryonics-germany.org**.

INDIA: Can help Cryonics Institute Members who need help for the transport & hospital explication about the cryonics procedure to the Dr and authority in Bangalore & Vellore Area. Contacts : Br Sankeerth & Bioster Vignesh / Email : **vicky23101994@gmail.com** Phones : Bioster / 918148049058 & Br Sankeerth / 917795115939

ITALY: The Italian Cryonics Group (inside the Life Extension Research Group (LIFEXT Research Group)) **www.lifext.org** and relative forum: **forum.lifext.org**. Contact Giovanni Ranzo at: **giovanni1410@gmail.com**

Kriorus Italy: Representative Filippo Polistena, email: filippopolistena45@gmail.com. phone: +39 334 298 9378

JAPAN: Hikaru Midorikawa is President Japan Cryonics Association. Formed in 1998, our goals are to disseminate cryonics information in Japan, to provide cryonics services in Japan, and eventually, to allow cryonics to take root in the Japanese society. Contact **mid_hikaru@yahoo.co.jp** or **http://www.cryonics.jp/**

NEPAL: Can help Cryonics Institute Members who need help for the transport & hospital explanation about the cryonics procedure to the Dr and authorities in Kathmandu. Contact : Suresh K. Shrestha / Email : **toursuresh@gmail.com** Phone : 977-985-1071364 / PO Box 14480 Kathmandu.

THE NETHERLANDS: Dutch Cryonics Organization is the local support group since 2002 and able to provide advice, standby, perfusion and shipment 24/7, in case of need. We are an active group utilizing the latest equipment. New members from The Netherlands welcome.

E-mail: **info@cryonisme.nl**
website: **http://www.cryonisme.nl**

NORWAY : Can help Cryonics Institute Members who need help for the transport & hospital explication about the cryonics procedure to the Dr, funeral home and authority at Sandvika. Contacts : Gunnar Hammersmark Sandvika Begegravelsesbyraa / Phones : 011-47-2279-7736

RUSSIA: KrioRus is a Russian cryonics organization operating in Russia, CIS and Eastern Europe that exists to help arrange cryopreservation and longterm suspension locally, or with CI or Alcor. Please contact **kriorus@gmail.com** for additional information or visit **http://www.kriorus.ru**. Phone: +7 962 947-50-79

SWEDEN: **www.kryonik.se** or Facebook: Svenska Kryonikföreningen. Initially, the society will focus on providing information and assistance to those who wish to sign up for cryonics. Eventually, we also hope to provide practical assistance in cases, possibly in collaboration with other European groups.

SWITZERLAND: **www.cryosuisse.ch**

CRYOSUISSE The Swiss Society for Cryonics is an active group with over 30 members. To join, **email info@cryosuisse.ch**

UNITED STATES:

Minnesota: Minnesota Cryonics Rapid Response (MCRR) is a nonprofit standby, stabilization and transport group based in Minneapolis, Minnesota. We have a strong, longstanding working relationship with local funeral directors, and have successfully participated in significantly more-timely suspension efforts in Minnesota in cooperation with both Alcor and the Cryonics Institute. Contact: President, Chuck Bartl, **chuckbartl@yahoo.com**.

UNITED KINGDOM: Cryonics UK is a nonprofit UK based standby group. **www.cryonics-uk.org** Cryonics UK can be contacted via the following people: Tim Gibson: phone: 07905 371495, email: **tim.gibson@cryonics-uk.org**. Victoria Stevens: phone: 01287 669201, email: **vicstevens@hotmail.co.uk**. Graham Hipkiss: phone: 0115 8492179 / 07752 251 564, email: **ghipkiss@hotmail.com**. Alan Sinclair: phone: 01273 587 660 / 07719 820715, email: **cryoservices@yahoo.co.uk**

Can help Cryonics Institute Members who need help, funeral home, transport at London. Contact : F.A. Albin & Sons / Arthur Stanley House Phone : 020-7237-3637

INTERNATIONAL: The Cryonics Society is a global cryonics advocacy organization. **www.CryonicsSociety.org**. They publish an e-newsletter *FutureNews*. Phone: 1-585-643-1167.

HELP US STAY UP-TO-DATE!

Please send any corrections or changes to the address below. If you know of, or are considering starting a support, standby or other cryonics-related group in your area, please send details to

dg@cryonics.org.

Please note, this list is provided as an information resource only. Inclusion on the list does not constitute an endorsement by the Cryonics Institute or our affiliated organizations. We urge our readers to use this list as a starting point to research groups that may meet their own individual needs. We further note that readers should always use their own informed judgment and a reasonable amount of caution in dealing with any organization and/or individual listed.

10 Worst Mistakes in Cryonics

Don't ruin your chance for a succesful suspension

1) Not signing up ahead of time

Becoming a member, having contracts in place, and having paperwork in order should not be a last minute decision. Waiting until the last minute or after death results in an unnecessary delay of care or worse- No suspension at all! Don't wait. Sign up here and be prepared. **https://www.cryonics.org/membership/**

2) Not providing proof of funding

Some people believe that they can worry about funding later or if they have funding, they have put off providing proof of funding to CI. This should be done annually. Failing to provide this can result in a delay of care while the funding clears, which can take weeks. Send your proof of funding to CI now to be prepared.

3) Not telling anyone your plans

Being reclusive or not telling family or friends your wishes is not recommended. You should not be afraid to tell those around you what your wishes are, especially your next of kin. Wearing a bracelet, necklace or having identification or other items in view can speak to your wishes. This is all you have when you can't speak for yourself. Disasters have resulted in the past from not sharing. Talk with your family, close friends and your estate attorney, so you can be prepared.

4) Not planning

Many think cryonics is a turnkey service where you can just sign up and let fate take over. No matter how much you pay for cryonics, you are the only one who can make sure that you will have the best chance by planning. CI has provided a lot of information on our website and in our standby manuals. Those who plan succeed those who don't fail.

For more information visit: https://www.cryonics.org/resources/ci-standby-kits-and-instructions

5) Not notifying CI of Emergencies

There is no way that your cryonics provider can help you if they do not know of your emergency. Your family, friends, standby group or next of kin must immediately contact CI when you are having health issues or worse. It is also important for CI to know if you have up and coming surgeries or procedures, including terminal illness. Patients with a diagnosed terminal illness could enter hospice care, which might help your cryonics situation vastly. Any delay in notifying us directly could result in a poor suspension. Those helping you must have simple and clear instructions.

Here are some tips... https://www.cryonics.org/resources/category/C57/57

6) Committing suicide

Anyone who commits suicide who is not terminally ill or breaks a local law in doing so is potentially putting both themselves and our organization at great risk. CI will not risk itself for people who engage in behavior that goes against our mission to preserve life. Such activity will likely lead to an autopsy and long delays, rendering the suspension process substandard or impossible to carry out.

Do not consider cryonics as a way out of your problems. You are likely to not get suspended under those circumstances. If you do not have a terminal illness and are considering suicide, you should seek mental health advice and treatment as soon as possible. https://www.mentalhelp.net/articles/depression-hotline/

7) Engaging in Risky or illegal activities

Risky behaviors or associations that lead to the patient dying around suspicious circumstances will also likely lead to mandated autopsies that will also stand in the way of your cryonics wishes. It is best to use common sense and not put yourself in harm's way. Not only could your

10 Worst Mistakes in Cryonics

life be ended, so too could your chances of cryonics suspension or future reanimation. Use common sense and stay safe.

8) Providing financial or legal incentives that encourage your **not** being suspended.

Leaving all of your insurance or cryonics money to family if you are not suspended is certainly an option at CI, but ironically it does provide financial incentive for hostile family members to block your suspension. As often is the case, people will make sure you are not suspended to get a hold of your money.

One suggestion is to leave family and next of kin some separate money from cryonics funding while suggesting that Cryonics funding go to cryonics as a donation no matter if you are buried or suspended. In addition, family or next of kin can be further compelled to cooperate if they will actually lose the money that is allocated to them for not cooperating. It is also suggested that your family be made fully aware of your wishes and stipulations, so they know what the results of their actions will be. You want to make sure you put incentives and disincentives in the correct place, so that your wishes are honored. It is suggested that your will and cryonics documentation reflect this and get reviewed by an attorney. See https://www.cryonics.org/resources/protect-yourself-from-legal-threats

9) Not removing a hostile next of kin from rights to your remains and finances

In many states and areas you can legally remove a hostile family member or next of kin from your estate. You can reassign someone who is sympathetic to cryonics and who has the legal authority to disposition of your remains, as well as your assets. In some states and locations there are disposition of remains reassignment documents, as well as powers of attorney, both in regards to financial as well as medical decisions. The executor of your will or anyone involved with making decisions should be sympathetic to your cryonics wishes. It is your responsibility to make your wishes very clear and to remove any doubt or potential legal resistance from family or next of kin.

We suggest seeking legal advice to help you in this regard. Some members have even made a video statement of their wishes and given it to both their cryonics organization as well as their attorneys. Not being careful could mean that you don't get suspended, despite your wishes. Many are surprised to learn that they lose their rights upon legal death. See an attorney and prepare.

10) Dying under less then favorable conditions

This seems harder to control then the other situations, but there are some things you can do to make your situation more favorable. You can diet, exercise and follow the latest official medical advice to stay healthy longer. The longer you are alive, the better the technology will probably be for suspending you and the closer we will be to a future that may be able to reverse your condition.

You can also avoid travel to remote or hostile places where such travel is risky. Some overseas travel can result in long delays both logistically and bureaucratically. In general, dying near your cryonics provider or cryonics standby group helps your chances. Living a healthy lifestyle and staying sociable, while surrounding yourself with people who will act on your behalf is paramount. Building solid, positive relationships with good people is probably one of the most important things you can do to have your wishes honored. Take care of yourself and maintain social connectivity.

CRYONICS INSTITUTE
Technology for Life

CRYONICS INSTITUTE
Technology for Life

Bulletin Board

Writers Wanted

Got something to say?

The CI Newsletter is looking for submissions from our readers!

If you've got a great idea for a story, please forward it to:

dg@cryonics.org

CRYONICS QUESTIONS?

Need some help with your membership?

Want to understand your suspension options?

Need to fill out important cryonics paperwork?

CONTACT US!

Our team is here to help.

1-(586) 791-5961

FREE Memberships?!!

Did you know the Cryonics Institute offers FREE LIFETIME Memberships for minor children of paid Lifetime Members? Any minor children (under the age of 18) of fully-paid Lifetime Members are eligible for a permanent Lifetime Membership of their own. If you'd like to give your children the priceless gift of a second chance of life with you in the future, please contact us at 1 (586) 791-5961 and ask about Lifetime Membership Benefits.

Show the world you support cryonics with CI gear from our **Cafe Press store**.


CRYONICS
INSTITUTE
Technology for Life