FRONTIER TECH INVESTOR

ISSUE NO. 25 MAY 2018

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The secret to time travel

New experimental technology could allow us to see the far future – and benefit from its advances

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Far far away did seem to mourn and rave

On alien shores; and if his fellow spake,

His voice was thin, as voices from the grave;

And deep-asleep he seem'd, yet all awake,

And music in his ears his beating heart did make.

Alfred Lord Tennyson, *The Lotus-eaters*

Do you believe that – *one day* – our greatest scientists, innovators and geniuses will discover cures for the humanity's biggest afflictions?

I don't mean tomorrow, next week or next year.

Just "one day" in the future.

My gut tells me we will. Consider the advances in medical science over the last 200 years. We've made giant leaps forward in our ability to treat infection, trauma, genetic diseases, cancer and other terrible illnesses.

Fast forward another 200 years and what else will we have accomplished? And another two centuries? And another?

Seen through this lens the concept of enormous advances in lifespan and quality of life seem not just probable... but virtually guaranteed. The problem is, most of us won't have enough time on Earth for these advances to come good.

But what if we could radically extend our time on Earth? What if we could "hibernate" long enough to see the future and benefit from its advances ourselves?

We could conquer not only time but distance, too.

Humans never adapted to hibernation because we evolved when long periods of resource scarcity just did not occur with

any kind of regularity.

But what if we could?

What if we could slow down our metabolisms so that our bodies could recover without the burden of constantly consuming energy and digesting it?

What if we really could sleep for extended periods so that we didn't have to wake up and consume resources? What if we could sit out the long six-month voyage to Mars, so that the payload for the voyage could be made up of useful items that didn't include food for a 36-month round trip?

What if we could sleep for years so we could wait long enough for cures to terminal diseases to be discovered?

You can see that the realm of the potentially possible is as wide as our imaginations, but what if I told you that serious people are committed to solving this riddle and that it is investible? I'm going to make that case for you in this month's issue. Then I'm going to introduce a new pick into the portfolio that I'm extremely excited about.

Hibernation defeats the boundaries of time and distance

I'm sure you know of the Formula 1 driver Michael Schumacher.

In 2013, he fell and hit his head while skiing off-piste in Meribel and suffered catastrophic injuries. He was immediately put into a medically induced coma and that allowed medical professionals to begin cryogenic cooling in an effort to preserve brain function. By some reports he was in a coma for days and was in and out of the condition for up to three months before being gradually resuscitated.

In fact it is not at all unusual to induce comas in heart attack victims, to ensure oxygen continues to reach the brain, although Schumacher's might be considered a long period of stasis, with two days being the norm.

Medically induced coma is not without its controversies, but it represents the beginning of our examination of where hibernation might eventually take us. During an induced coma, electrical activity in the brain slows down. That represents approximately 70% of the energy the brain consumes. One of the reasons it is such an attractive treatment for heart attack victims is that it also has an anti-inflammatory effect which relieves intercranial pressure that could potentially be damaging. That also reduces the size of blood vessels and therefore the amount of energy required to ensure blood flows through them.

So where do we go from here?

The simple fact of the matter is that the human race has suddenly got serious about interplanetary space travel. Setting off for parts unknown has been the ultimate form of escapism for pioneers for centuries.

The trip to Mars will take at least six months, everything that will be required to survive on arrival needs to be brought along and there are no reasonably friendly locals that can teach us how to survive when we get there (at least as far as we know).

It's imperative that we come up with the most efficient way possible of getting people and equipment to the Red Planet if the venture is to be successful.

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NASA's hibernation programme

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For example, some of the challenges hibernation might solve include the volume requirement for food and water as well as the reclamation equipment required to recycle the same.

Then you have the air we have to breathe when we are awake, moving and active and the space we need to move around in when

we are awake. There are the psycho-social problems of having a small number of people cooped up in a small metal cylinder for a long time and in a high-stress environment.

Mental hardship, boredom and claustrophobia are not inconsiderable threats. You have the radiation damage the body experiences, the problems with vision from intracranial pressure, and reduced bone density from the absence of gravity.

With those kinds of challenges, you can see why NASA is investing millions in developing a medical solution to long-term space travel.

When animals go into hibernation, their bodies survive unscathed by the rigours of the environment, particularly from radiation. That's a big plus for space travel where we are exposed to prolonged cosmic radiation and the negative effects it has on the body.

As Yuri Griko, a NASA radiobiologist and lead senior scientist in the Ames' space biosciences division, sees it:

> *Metabolic suppression mitigates radiation-induced damage by reducing biochemical processes and excessive oxidative stress. Hypoxia—lower oxygen consumption—is one possible explanation for the radio-protective effect: In hypoxia, production of oxygen free radicals and hydroxyl radicals is reduced. Because ionizing radiation releases free radicals causing cell damage, suppressing metabolism and oxygen consumption appears to do the reverse: it reduces normal cell death and prolongs healthy cell life. This protective effect is even more pronounced at lower temperatures.*

Long-term human hibernation is possible

Real interest in human hibernation was ignited in 1995 when a four-year-old boy fell into a freezing lake in Hanover, Germany.

His heart was in cardiac arrest for 88 minutes. When rescuers pulled him out of the water his eyes were fixed and fully dilated and his core body temperature was 19.77 degrees Celsius, which is almost half of what is normal and represented severe hypothermia.

Once admitted to hospital, the medical team began to heat him up and after 20 minutes the ventricles of his heart started to contract and 10 minutes later his heart started beating normally. He made a full recovery and was discharged two weeks later. This was first-hand proof the body is capable of surviving without oxygen for lengthy periods without undue damage to brain function or the organs. The question is how to make it reliably repeatable.

19 degrees is just too risky to repeat without real potential for death so the bulk of research is going into what might be considered mild hypothermia or body temperatures of 32-34 degrees. With that body temperature the body's metabolic rate falls by anything from 50% to 70%. When examinations of how bears hibernate are conducted, it is observed that their body temperatures also fall by a couple of degrees and yet they can survive for months in that state without ever having to eat or drink. In fact, mother bears give birth and wean their young while still in hibernation.

The ability of bears to function in what is effectively a vegetative state means hibernation is closer to a coma than we might have at first imagined. When people are in a coma the brain does not shut down. It enters periods of activity and inactivity and registers the sounds we hear. In fact, when people wake from comas they feel sleep deprived in just the same way that bears do when they wake from hibernation.

Therefore, if we are to succeed in coming up with a way to induce a coma that lasts for months rather than days, the answer probably lies with hibernation.

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The commercial race to solve hibernation

SpaceWorks is a company based in Atlanta, Georgia, that acts as a contractor for NASA and the US Department of Defense. It has received more than $500,000 from the US government to explore the viability of low metabolic torpor or what used to be called suspended animation. It is leading the charge into delivering what is effectively hibernation for future astronauts on lengthy space voyages.

So what has it come up with?

Well by assuming that people can be put to sleep for 14 days at a time on a rolling basis, the size of the capsule NASA is planning on sending to Mars can be reduced by 52% or from 41.9 tonnes to 19.9 tonnes. That would be for six crew members.

14 days is possible today with current technology. It's still considered extreme but it is possible. 200 days is the objective. With 200 days the size of the capsule could be reduced by half again. The cost in terms of both money and energy to send a capsule of 13 tonnes to Mars is exponentially lower than for a 45-tonne vessel so there are obvious advantages.

You may have heard that liquid water exists on Titan, one of Jupiter's moons, and there are already companies that have plans to send robots to asteroids for mining purposes. But if we have real objectives of becoming an interplanetary species, there is no practical way it is going to happen without putting people to sleep for months at a time. It would be great if that also stopped the ageing process – it doesn't – but putting us to sleep is a lot less expensive than catering to our every need while awake.

If 200 days can be achieved, then the company has plans for ships that can carry as many as 100 people to Mars. That is when we get to talk realistically about colonisation.

But if we have real objectives of becoming an interplanetary species, there is no practical way it is going to happen without putting people to sleep for months at a time.

So how do we get to 200 days?

"Iotska"

There was a practice among Russian peasants about a century ago called "*lotska*" which involved only waking for an hour or so a day for six months, consume a small amount of bread and ale, then go back to sleep. It was how they survived the crushingly long winters.

There are also well-recorded instances of Buddhist monks who were able to lower their metabolism by 64% through meditation. The answer companies like SpaceWorks have come up with is pharmaceutical – using off-the-shelf drugs currently utilised by surgeons to induce torpor.

Outside of the rapidly evolving space sector there are additional applications for long-term periods of safe hibernation. For example, if someone is waiting for an organ or an organ to be harvested from a donor, hibernation could be induced as a time management protocol to ensure the process happens on time with the least possible upset.

The biggest challenge to advancing the science of induced torpor is animal testing. NASA does not want to get on the wrong side of animal rights activists so it is reluctant to study the effects of long-term torpor on pigs or apes. At the same there are plenty of test pilots and other healthy individuals who would be happy to sign up for human trials. SpaceWorks began testing on pigs last year so we should have results soon.

So how do we invest in the hibernation theme?

The only way I have been able to find into this emerging sector is through the most effective way to reduce the body's temperature to the desired level.

SpaceWorks has hypothesised that the capsule in which people travel will be held at a constant temperature and that will ensure everyone stays at a constant temperature while they sleep.

However, that is but one option and it is not practical in a hospital setting which is where the vast majority of testing for therapeutic hypothermia will occur. For that we need a machine.

The company that produces one of the best temperature management systems is called Medivance. In fact, the company's sole suite of products focuses on temperature management for therapeutic hypothermia.

Its patented Arctic Sun 5000 Temperature Management System offers the highest level of performance available today for anyone seeking to control a patient's body temperature accurately and with the least amount of fuss.

It functions using a series of gel pads that are placed against the torso and legs, which are then controlled via a computer interface. Its patented hydrogel provides rapid heat transfer, are of high quality and are simple to administer. The entire process of temperature management is then completely automated by the control console.

There are other methods of cooling the body down. One of the newer solutions is to inject cooled nitrogen, via the nose, directly to the base of the brain. Another experimental therapy uses a cardiopulmonary bypass cannula through the chest and into the aorta, or into the femoral artery in the groin. A cooled saline solution is then injected directly into the blood stream to cool the body down rapidly.

These kinds of solutions are not appropriate for hibernation, and not least in space. Every incision is a potential site for infection. Additionally, these methods are primarily designed for emergency situations in the operating theatre and aim for very low temperatures for relatively brief amounts of time.

It is for that reason that I believe the most likely product to lead the vector of investment for hibernation is going to be the Arctic Sun 5000.

I'm not the only person who believes that to be the case. Medivance was acquired by medical products company C.R. Bard in 2011. In turn, C.R. Bard was acquired by **Becton Dickinson** in December 2017. And it's Becton Dickinson that I'm recommending this month.

This month's recommendation

Becton Dickinson is the second largest medical devices company in the world. Medivance is therefore a very small cog in a very large machine and does not contribute meaningfully to revenue. So why have I brought this to your attention?

The simple fact is that I believe space is going to be huge business. If you're a veteran subscriber, you'll remember my recent issue focusing on nanosatellites and the evolution of a space economy (you can read that on the subscriber area now).

Right now, it is hard to imagine a scenario where humanity has multiple colonies on the moon, Mars, Titan and the asteroid belt, but it is inevitable that it is going to happen in this century if the pace of innovation is followed to its logical conclusion.

A brand-new planet after all represents, literally, a world of opportunities.

It's difficult to find pure plays for sectors that are only just starting to get off the ground. But think about it this way. A population of about 10,000 is required to ensure there is enough genetic disparity to ensure long-term viability. That's the minimum population to ensure a Mars colony could be self-sustaining. Over the century from the first colony's initiation it is not unreasonable to expect the Martian population to swell to the millions. A brand-new planet after all represents, literally, a world of opportunities.

Solving the hibernation conundrum is a big part of humanity's dream of becoming a multiplanetary species. The products Becton Dickinson produces are going to be an integral part of that evolution.

The company's revenue is split roughly 2:1 between healthcare supplies and life science equipment. The merger between Bard and Becton is expected to release approximately $300 million in savings. Bard is a high-growth company while Becton has the scale, particularly in Asia to market its now expanded product line.

The company's primary areas of focus include: BD Medical, which focuses on needles, syringes, intravenous catheters, prefillable drug delivery systems and insulin syringes which are primarily aimed at hospital customers.

BD Life Sciences focuses on the tools labs and clinics need for blood collection, automated blood culturing, molecular testing systems and rapid diagnostic assays.

The BD Biosciences section focuses on fluorescence-activated cell sorters and analysers, monoclonal antibodies and kits for cell analysis.

Bard focuses on products relating to vascular, oncology, urology and surgery. These are all areas that Becton had made relatively small inroads into, which is why the market was so accepting of the merger.

The share has been trending higher in a consistent manner since 2013 and remains on a steady growth trajectory. The additions to Bard's operations are expected to deliver over $659 million in additional free cash flow in 2018 and an additional $1.763 billion in 2019. That money is expected to be used to pay down debt. The company has stated it wants to get the leverage below three times with the expectation that it will pay down $1 billion in debt this year and $2.5 billion in each of the two subsequent years. Only after leverage has been brought down is the company expected to pick up the pace of share buybacks.

I rate Becton Dickinson a buy. By purchasing the company, we get a high-growth business that is opening up into new sectors and will have a dominant position in supplying hospitals and labs with the tools they need to treat patients.

For the current price we get the growth avenue represented by hibernation for free. This is the same strategy I following when buying Autodesk for its early-stage investments in synthetic biology. I believe this strategy is the best way to participate in the emerging theme of therapeutic hypothermia.

The risk is that the company does not make the most of its acquisition of Bard or that for some reason it encounters pricing pressure that could put its expectations for steadily growing free cash flow at risk.

I believe these risks are contained and that the outlook for the share is optimistic. My 12-month target is $275 and three-year target is $400.

Action to take:	**buy Becton Dickinson and Co**
Ticker:	**BDX**
Price as of 03.05.2018:	**227.13 USD**
Buy up to:	**250 USD**
52-week high/low:	**248.39/177.64 USD**
Market cap:	**$60.69 million**

Figures accurate as of last market close: 03.05.2018

Past performance:

Data as of 28/03/2018

Energy

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Orocobre Ltd	ORE. AX	07/04/16	A$ 2.92	A$ 5.76	97.26
Ormat Technologies	ORA on NYSE	06/06/17	$58.79	$59.80	2.38
Smart Metering Systems	SMS LN	03/10/17	735.5p	831p	13.69
Sherritt International Corp	S CN	06/02/18	C$1.18	C$1.16	-1.69

Technology

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Cyberdyne	7779	30/05/16	JPY 2,353	JPY 1,399	-40.54
IBM	IBM LN	07/06/16	$153.33	$143.22	0.06
SAIC	SAIC US	05/07/16	$58.20	$86.76	53.33
Garmin	GRMN US	02/08/16	$55.75	$59.37	12.90
2U INC	TWOU: US	06/02/17	$33.25	$88.31	13.69
Cisco Systems Inc.	CSCO: US	03/04/17	$33.80	$45.73	39.70
Advanced Micro Devices	AMD US	26/07/17	$14.76	$11.59	-21.48
Microsoft	MSFT	31/07/17	$73.04	$96.22	33.42
Northrup Grumman	NOC US	06/07/17	$301.66	$317.13	5.75

Medical

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Autodesk	ADSK	19/07/17	$108.83	$131.57	20.89
Abcam	ABC	07/03/17	907.5p	1265p	40.89
Illumina	ILMN	04/09/17	$207.15	$256.89	23.97
PureTech Health	PRTC-L	09/01/18	155.75p	149p	-4.33
Agios	AGIO	06/03/18	$84.23	$81.65	-1.69
Becton Dickinson and Co	BDX	03/05/18	$227.13	$227.13	0

Moonshot

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
SolarWindow	WNDW	07/04/16	$3.96	$5.07	28.03
Alkane Resources Ltd	ALK: AU	05/09/16	AU$ 0.31	AU$ 0.29	-6.56
Editas	EDIT: US	07/03/17	$21.02	$33.56	57.71
Haydale Graphene Industries	HAYD	02/5/17	178.5p	107p	-40.06
Superconductor Tech Inc	SCON	28/03/17	$0.95	$0.92	-3.75

For the full portfolio including live prices, please visit the *Frontier Tech Investor* subscriber area. **You can view that by following this link.**