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All except for the human beings

Nauticus Robotics, Inc., an aspiring disrupter of the world's maritime trades, plans to go public on the well-trod path of a special purpose acquisition company at a valuation equivalent to 47 times the seagoing startup's projected 2021 revenue. No reader of Mark P. Mills's compelling new preview of the dawning technological future, *The Cloud Revolution*, will be surprised.

Science fiction come to life is one thread of this unfolding essay. Fictitious wealth is a second, and ultralow interest rates makes a third. It's hard to read Mills, a physicist who hangs his hat at the Manhattan Institute, without sharing his contagious optimism for what he calls our "cyberphysical age." Supplement his book with a dose of cyclical history, however, or with a random week's reporting in Almost Daily Grant's, and you may reflect that now could be just the time to raise some cash.

The Cloud Revolution is no investment book, though Mills knows his way around Wall Street as investor and commentator alike. His unguardedly bullish subtitle, "How the Convergence of New Technologies Will Unleash the Next Economic Boom and a Roaring 2020s," refers to the intersection of super-computing power with machine learning without reference to the share price of the ARK Innovation Fund. Catherine Wood, ARK's famous progenitor, is no less contagiously optimistic than Mills—here and there, it seems as if she could finish his sentences. If they both contend that the world has embarked on a new era, Mills is perhaps more cognizant than the star portfolio manager of how often the soothsayers wind up mistaking bullish for bearish, or up for down. The grand finale of *The Cloud Revolution*, a compendium of hits and misses of the prognosticators of yore, makes wry and humbling reading for any who would presume to tell futurity how to go about its mysterious business.

Bringing a helpful historical perspective to the story of technological evolution, Mills compares present-day inventions with the miracles of yesteryear. First came the telephone, which connected conversations. Next, the internet, which connected distributed desktop computers. And now the Cloud (a.k.a. data centers, immense warehouses bulging with microprocessors), to connect, in Mills's words, "anything and everything—especially all manner of increasingly 'smart' things—but this time to a *centralized* (super)computing infrastructure." As wondrous as is the phone in one's pocket (a more powerful device than a Reagan-era mainframe computer), the connection of that device to the Cloud is what sets our time apart from any other.

If the rising of the early 20th-century skyscrapers typified the commercial and technological progress of the 1920s machine age, so, Mills posits, do today's data centers—some of them encompassing square footage exceeding that of the Empire State Building—epitomize the commercial and technological advances of the 2020s silicon age.

"The key to the economic power of today's digital cathedrals," Mills elaborates, is found in an amazing fact: just ten square feet of one datacenter has more computer horsepower than all of the world's computers had circa 1980. And all that silicon horsepower is connected to markets on an information highway network that vastly exceeds in scale everything in its asphalt and concrete analogue.

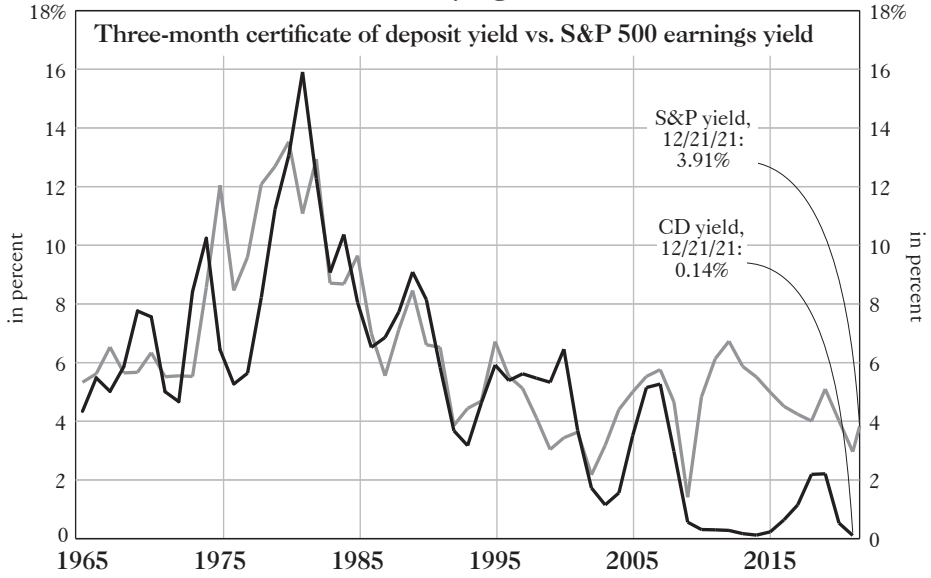
Why, Mills tells us, such digital highways feature the equivalent of "100 billion miles (that's 1,000 times the distance to the sun) of invisible connections forged by 4 million cell towers.... The technological upwelling that this burgeoning infrastructure will bring to the 2020s will exceed that of the 1920s as it impacts all facets of the economy, not just e-commerce and social media."

What excites Mills about the future is not what the average viewer of *The Jetsons* has come to expect—for

***Grant's* on vacation**

Grant's Interest Rate Observer, taking its Christmas vacation, will resume publication with the issue dated Jan. 21, 2022.

As Chair Bernanke was saying



sources: Organization for Economic Co-operation and Development, Standard and Poor's

instance, "swarm farm robots," miniature harvesting devices equipped with artificial-intelligence-aided vision systems to spot ripe produce and soft grabbers to pluck it from the vine. The true prize at the end of the digital rainbow is rather what few of us are even equipped to imagine. "There is," the author writes, "an essentially unlimited number of arrangements of atoms and thus of new devices that are unimaginable today." Even the marvels in hazy view resemble more closely, in evolutionary terms, the 1899 Packard than the Coolidge-era Model T Ford, he contends.

There'll be "smart" contact lenses; digestible computers (for medical diagnosis); 3-D printing of body parts; robo-miners; immersive 3-D telepresence (bye-bye, Zoom); strong, reversible glues (like the kind that nature provides to snails and geckos); and air taxis galore. Mills neatly and, at least to us, persuasively disposes of the argument that bots will turn out to be net stealers of jobs—on form, technological progress leads to more employment, not less.

Waving off the common refrain about the "dematerialization" of modern economic life, Mills talks up the future of the proliferating science of materials, both the ones that nature provides and the ones on the drawing board. The Cloud will do much more than modify existing means of producing known substances, he promises. It will harness supercomputing and AI to design—"create, invent, synthesize"—entirely new materials, "including those that exhibit properties impossible for natural materials."

Not in every dentist's office will you find, for instance, a copy of *Advanced Materials Technology*, whose December cover features a "Microfluidic Organ-on-a-Chip": "Airway epithelium exposed to airflow while cultured on the surface of a hydrogel layer in a microfluidic organ-on-a-chip," by Edmond K. Young and Siwan Park. A dozen such journals have come into the world in the past 20 years, Mills reports, a sign of "the velocity and depth of the materials revolution." Page after page of *The Cloud Revolution* reminds us how big and wondrous is the world in which we are privileged to live.

Even so, it has its banana peels. Technology commands the value that people choose to assign to it. "The economic value of a commodity," writes economist David Simpson in *The Rediscovery of Classical Economics*, his inspiriting attack on the pretensions of modern economic theory, "is a relationship between an object and an appraising human mind"—a mind, perhaps, intoxicated with QE and zero-percent funding costs.

Contrary to popular memory, the 1930s was a bustling decade in technology. The historian and philosopher Lewis Mumford hailed the advent of aluminum, small electric motors and the new media of mass communication as the harbingers of the "neotechnic" age of history. And now, says Mills, with the melding of titanic computing power and artificial intelligence, comes the "neurotechnic" age. No doubt, somewhere on the half-deserted Wall Street of the 1930s, doughty futurists were picking up the pieces of Radio Corporation of America and counting the days until Mr. Market would see the light of the beckoning future.

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Bull markets pull forward investment demand even as bear markets push it backward. Bullish price action shortens the imagined timeline of corporate earnings growth, even as bearish price action elongates it. Appraising human minds calculate differently depending on the phase of the market cycle. Most of us, adding two plus two, miraculously find that it equals five at the top but only three—at the maximum—at the bottom.

So the investment implications of the Cloud revolution in the short to medium term are hardly cut and dried. The phenomena of zero-percent nominal interest rates and persistent, substantially negative real interest rates alone command caution. Valuations, another check point, flash a shade of amber that borders on blood red.

Mills reckons that "roughly 90% of all the scientists that ever lived are alive today." Unfortunately, it is probably also correct that most of the economists who ever lived are alive today. And if, as Mills observes, it's advances in mathematics and statistics that have brought us ever closer to "another scientific Renaissance," it's also the economists' misplaced mathiness that has led them down the rabbit hole of theory called equilibrium economics. Note, however, that, whereas the physicists' forecasts sometimes work, the economists' predictions almost never do (though even the physicists aren't immune from the siren song of mathematics for their own sake; see Sabine Hossenfelder's excellent and readable *Lost in Math: How Beauty Leads Physics Astray*).

Not just any brigade of really smart people could have convinced themselves that lending and borrowing and speculating played no part in the events leading up to the 2007–09

credit crisis or that record-high money growth and uniquely easy financial conditions would give no impetus to the inflation of 2021-and-counting. The hundreds of doctors of economics on the payroll of the Federal Reserve System did not simply choose to ignore the facts in front of their faces. Trained to look away, they arrived at their posts pre-blinkered. What they were taught, and what they believed, was the very opposite of what the attentive layman knows.

What are the bedrock assumptions of today's central bank-approved macroeconomic theory? Simpson identifies three: that the economy is static; that everyone has access to a single, identical stock of knowledge; and that economic agents make rational and optimizing choices. CFA charterholders may recognize in these precepts the outlines of the strong-form efficient market hypothesis.

If the economists were correct, Mills could have spared himself the trouble of writing a book about economic dynamism. The absence of change and uncertainty in this neo-Keynesian framework, as Simpson observes, leaves little scope for entrepreneurship, greed, fear or, indeed, common sense.

It's to his credit that Jerome Powell is no trained economist, but his mere proximity to so many members of that strange clique has led him into error. Yes, the Fed chairman acknowledged in response to a question at the Dec. 15 post-FOMC press conference, "businesses actually have a lot of debt, but their default rates are very, very low." For the chairman's information, it is no easy thing to default in a time of zero-percent interest rates. And it is no difficult thing, for the ZIRP-addled and cash-infused members of the speculating public, to chase meme stocks, invest in tungsten cubes (or NFTs of tungsten cubes), buy the Shiba Inu crypto coin or pay $29 for a share of the profitless Lordstown Motors Corp. In the best of times, money is not humanity's best subject. Radical monetary measures add a heightened degree of difficulty to the investment problem.

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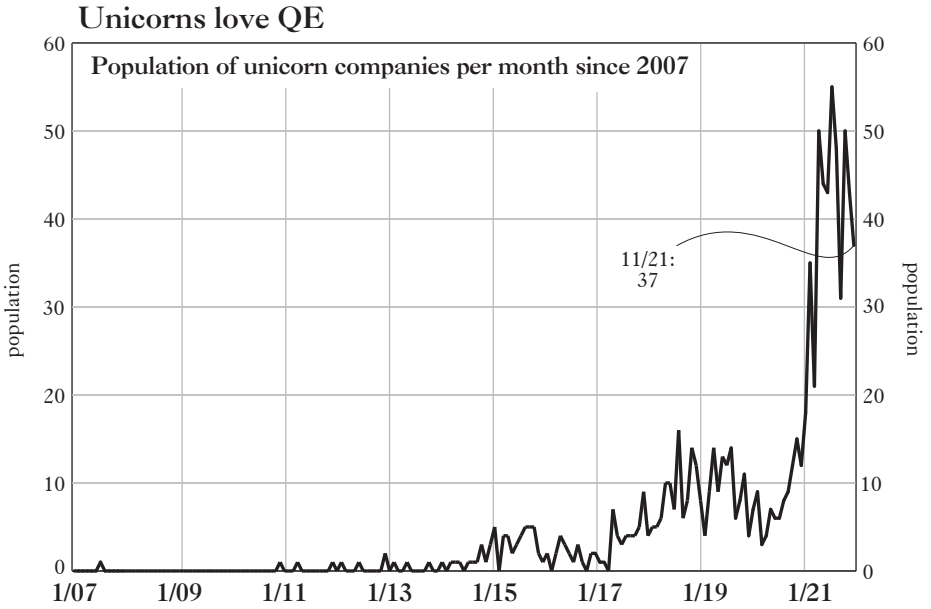
For the next edition of *The Cloud Revolution*, a chapter on the digitization of finance might not be out of place. "The bond crop never fails," sighed the weary creditors in the loss-dealing years of the bond bear market of 1946–81, and the point survives today in a very different interest rate setting. There are no bottlenecks, no supply-chain issues on Wall Street. Even in the 2020 plague year, the Depository Trust & Clearing Corp. processed $2.33 quadrillion's worth of securities and cleared a daily average of $1.698 trillion in equity trades. So far in 2021, a record $156 billion's worth of IPOs have come to market in the United States alone, not counting SPACs, which easily tops the prior, $97 billion record set in the bubbly year 2000. Year-to-date issuance of leveraged loans and junk bonds ($613 billion and $461 billion, respectively) have similarly roared to records.



source: CB Insights

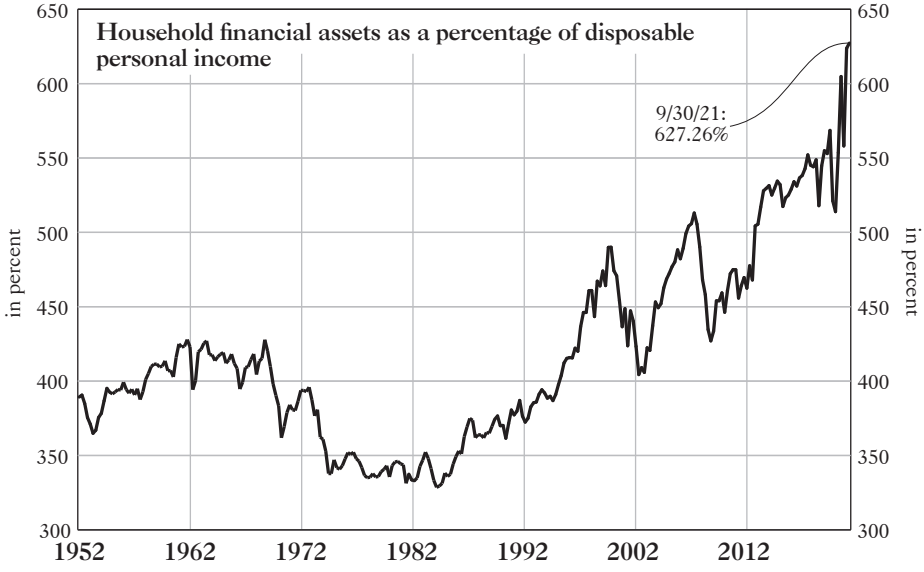
No doubt, technological progress plays its part in these manic proceedings, but monetary manipulation is no less a driver. For more than a half-century, short-term bank deposit yields and the S&P earnings yield tracked together. They parted company, much to the advantage of equity holders and to the detriment of savers, at about the time the Fed explicitly began to target asset prices, which decision a previous chairman of the Federal Reserve Board, Ben S. Bernanke, conveyed to the readers of the Nov. 4, 2010 edition of *The Washington Post*. "[L]ower mortgage rates will make housing more affordable and allow more homeowners to refinance," Bernanke wrote. "Lower corporate bond rates will encourage investment. And higher stock prices will spur spending. Increased spending will lead to higher incomes and profits that, in a virtuous circle, will further support economic expansion."

"Trickle-down" is one name for this approach to monetary policy. "Financialization"—aptly described by investor Henry Maxey at the latest *Grant's* event as "the optimization of the economy around finance and asset prices"—is another. In any case, Bernanke dropped no hint as to the possible unintended consequences of a central bank-sponsored asset levitation.

We have no quarrel with Mills's grand thesis but rather demur over the interest rates and credit policy that lead appraising human minds to draw the wrong ideas about the technological and commercial timeline. The more than fourfold rise in the population of unicorns—closely held companies valued at $1 billion or more compared with the 2018–19 baseline—is traceable not only to the genius of the scientists but also to the errors of the central bankers and the pro-cyclical enthusiasm of the mass of investors. The question is whether, for this cycle, the Cloud revolution is already in the market.

A tricky subject, especially because of the hard-wired volatility of technology stocks. At the fall 2019 *Grant's* conference, Martin Hale, founder of Hale Capital Partners, a private equity group devoted to nursing fallen tech concerns back to health, noted that Oracle Corp.,

Richest on record



source: Federal Reserve Board of Governors

EMC Corp., Apple, Inc. and Amazon.com, Inc. are among the glamour issues that, at one time or another, had lost more than 80% of their market value, only to rally from those stygian depths by more than 50-fold. In the prior two recessions, Hale pointed out, "70% of all tech companies lost 70% or more of their value."

Not having a clue about the start date of the next recession, we can only observe that the current run of prosperity is one for the ages. Note, for instance, the nearby snapshot of financial assets held by households (and nonprofit institutions) as a percentage of disposable personal income. The dot-com bubble of the 1990s was a pretty fair time for stocks and bonds, but it—like the Reagan boom of the 1980s—pales in comparison to the flourishing in this era of tiny interest rates and splashing QE.

Add residential real estate to the left side of the household balance sheet, compare it to liabilities on the right, and you capture most of the consumer's net worth. Not once, until the final three months of 2020, had the venerable household-net-worth data series registered four consecutive quarters of double-digit growth. Through the third period of 2021, year-over-year growth streaked as follows: 10.9%, 21.3%, 15.2%, 12.4%. As for the fourth quarter, Ed Hyman, founder of ISI Evercore, predicts another leap, this one of 15%, to the grand total of $150 trillion.

Nor, as colleague James Robertson, Jr. points out, is this acceleration a case of distortion by statistical base effect. Only in the second quarter of 2020 did household net worth show a decline (of minus 1.7%). Otherwise, the quarterly uplift in the composite American financial position has handily overshot the long-term average growth rate of 3.6%.

"The tendency of an inconvertible paper money," said Robert Banks Jenkinson, Lord Liverpool, in a speech to Britain's House of Lords some 200 years ago, "is to create fictitious wealth, bubbles, which by their bursting, produce inconvenience."

Very true, but, with the benefit of the two centuries of experience that Liverpool lacked, we could go further (if not more felicitously). Thus, the tendency of the human race, while acting in markets, is to overreact, both to the upside and the downside. Paper money, 21st-century central bank nostrums and the embedded errors of modern economic theory will only add to the inconvenience that is surely coming.

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