17:03 In the Company of Rogues: Pastor Laphroaig's Tall Tales of Science and of Fiction

by P.M.L.

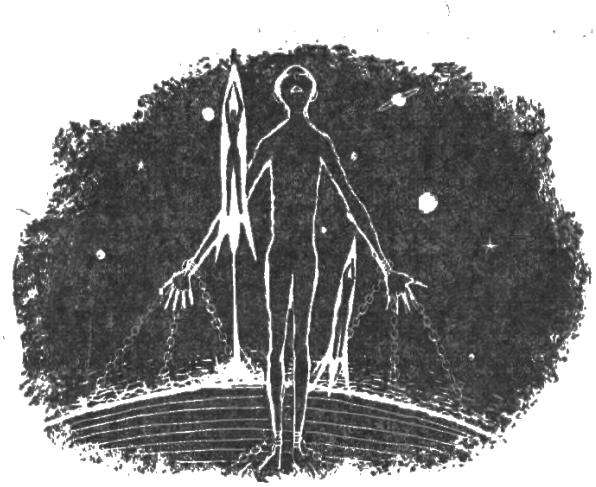
Gather 'round, neighbors. The time for carols and fireside stories is upon us. So let's talk about literature, the heart-warming stories of logic, science, and technology. For even though Santa Claus, Sherlock Holmes, and Captain Kirk are equally imaginary, their impact on us was very real, but also very different at the different times of our lives, and we want to give them their due.

Fiction, of course, works by temporary suspension of disbelief in made-up things, people, and circumstances, but some made-up things make us raise our eyebrows higher than others. Still, the weirdest part is that the things that are hard to believe in the same story sometimes change with time!

So I was recently re-reading some Sherlock Holmes stories, and a thought struck me: in the modern world that succeeded Conan Doyle's London, both Mr. Holmes and Dr. Watson would, in fact, be criminals.

Consider: Holmes' use of narcotics to stimulate his brain in the absence of a good riddle would surely end up with the modern, scientifically organized police sending him to prison rather than deferentially consulting him on their cases. What's more, with all his chemical kit and apparatus, they'd be congratulating themselves on a major drug lab bust. Even if Dr. Watson escaped prosecution as an accomplice, he'd likely lose his medical license, at the very least.

Nor would that be Dr. Watson's only problem. Consider his habit of casually sticking his revolver in his coat pocket when going out to confront some shady and violent characters that his friend's interference with their intended victims would severely upset. This habit would as likely as not land him in serious trouble. His gun crimes were, of course, not as bad as Holmes'—"*...when Holmes in one of his queer humors would sit in an arm-chair with his hair trigger and a hundred Boxer cartridges, and proceed to adorn the opposite wall with a patriotic V.R. done in bullet pocks,...*"—but would be quite enough to put the good doctor away among the very classes of society that Mr. Holmes was so knowledgeable about.



I wonder what would surprise Sir Arthur Conan Doyle, KStJ, DL more about our scientific modernity: that an upstanding citizen would need special permission to defend himself with the best mechanical means of the age when standing up for those abused by the violent bullies of the age, or that such citizens would need a license to own a chemistry lab with boiling flasks, Erlenmeyer flasks, adapter tubes, and similar glassware,[3] let alone the chemicals.

Just imagine that a few decades from now the least believable part of a Gibson cyberpunk novel might be not the funky virtual reality, but that the protagonist owns a legal debugger. Why, owning a road-worthy military surplus tank sounds less far fetched!

In Conan Doyle's stories, Mr. Holmes and Dr. Watson represented the best of the science and tech-minded vanguard of their age. Holmes was an applied science polymath, well versed in chemistry, physics, human biology, and innumerable other things. Even his infamous indifference to the Copernican theory[4] is likely due to his unwillingness to repeat the dictums that a member of the contemporary good society had to "know," i.e., know to repeat, without thinking about them first. As for

[3] Regulated as "drug precursors" by, e.g., Texas Department of Public Safety.

[4] "*My surprise reached a climax, however, when I found incidentally that he was ignorant of the Copernican Theory and of the composition of the Solar System. That any civilized human being in this nineteenth century should not be aware that the earth travelled round the sun appeared to be to me such an extraordinary fact that I could hardly realize it.*"
—A Study in Scarlet.

Dr. Watson, his devotion to science is seriously underappreciated—just imagine what sort of stinky, loud, and occasionally explosive messes he opted to put up with. It takes a genuine conviction of the value of scientific experiment to do so, his respect for Sherlock notwithstanding.

Just in case you wonder how Dr. Watson's trusty revolver fits into this, remember that in his time it represented the pinnacle of mechanical and chemical engineering, just like rocketry did some half a century later. In fact, the Boxer from a couple of paragraphs back, Col. Edward Mounier Boxer, F.R.S., besides inventing the modern centerfire primer that Holmes used in his Webley to spell Queen Victoria's initials and that we use to this day in our ammo, also designed an early two-stage rocket. This same principle of rocketry was later used by Robert Hutchings Goddard.

– — — – — — — – — — –

But of course times change, and we change with them. So I put that book aside, and opened another, which was rockets and space travel all over: a Heinlein juvenile novel, *Rocket Ship Galileo*. Heinlein's juvies are a great way to remind yourself about the basics of space flight and celestial mechanics—but I wish I hadn't, neighbors, not in the frame of mind I was in.

You see, in this 1947 novel three teenagers, who dabble in rocketry and earn their rocket pilot licenses, are taken to the Moon by their uncle, a nuclear physicist and space flight expert. The only people who try to stop them, under the pretext of "endangering minors," are actual Nazis—and the local sheriff sees right through them. So *The Galileo* lifts off to seek adventure and handy explanations of the scientific method, the crowd and the state police cheer, and the stranger with the fake minor protection injunction is taken into custody.

Now that was 1948. Many things changed since then. Vertical landing of space rockets, which made the reader of these juvies cringe just a few years ago, has become a technical reality. But a sheriff approving of a risky activity with mere parental consent is what really stretches belief nowadays; the Moon Nazis with their fake child protection order would've won easily.

Granted, juvie fiction is bound to stretch the truth a little, to give teenagers a place in the adult action to aspire to. But this is the kind of a stretch that inspired the first generation of actual NASA engineers. The characters of the former NASA engineer's memoir *Rocket Boys* built homemade rockets just like Heinlein's teen protagonists. Just like Heinlein's fictional teens, they initially got into trouble for it, and were similarly rescued by adults who used their discretion rather than today's zero tolerance polices.

Now you can read the book or watch the movie, *October Sky*, and count the felonies a teenager these days would rack up for trying the things that brought the author, Homer H. Hickam, Jr., from a West Virginia coal mining town to NASA.

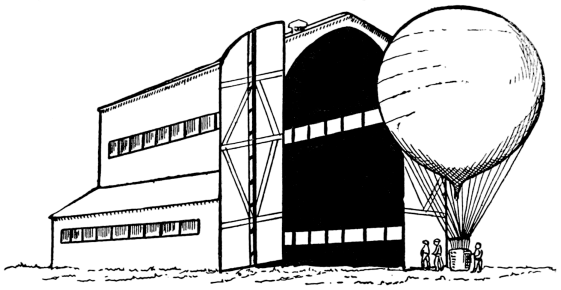
And speaking of movies, neighbors, do you recall that Star Trek episode, *Arena*, in which Captain Kirk is dumped on a primitive world and made to fight a hostile reptilian alien? The fight is arranged by a powerful civilization annoyed by Kirk's and the Gorn's ships dog-fighting in their space; it somehow fits their sense of justice to reduce a spaceship battle to single combat of the captains. Both combatants are deprived of any familiar tools, but

the alien Gorn is much, much stronger, and easily tosses Kirk around.

Of course, all of that was just the setup for a classic story of science education. Kirk saves himself and his ship by spotting the ingredients for making black powder, then using the concoction to disable his scaly, armored opponent closing for the kill.

I wonder, though: would the black powder hack have occurred so easily to Kirk if he—and the screenwriters, and a significant part of the 1960s audience expected to appreciate the trick—hadn't as teenagers experimented with making things go boom? And, if they hadn't, would there even be a Star Trek—and the space program?

Such skills used to be synonymous with basic science training. Now, for all practical purposes, they are synonymous with school suspension if you are lucky, or a criminal record if you aren't.



Think about the irony of this, neighbors. The enlightened opinion of our age is all about the virtues of STEM, but it punishes with a heavy hand exactly those interests that propelled the actual science and technology, because they could be dangerous. And what's dangerous must be banned, and children must be taught to fear and shun it, from grade school onward.

How did we come to this?

Somewhere along the way of technological progress we have picked up a fallacy that grew and grew, until it became the default way of thinking—so entrenched that one needs an effort to nail it down explicitly, in so many words.

It is the idea that progress somehow means and requires banning or suppressing the dangerous things, the risky things, the tools that could be abused to cause harm. If the tool and the skill are too useful to be expunged entirely, they must be limited to special people who have superior abilities, and who are emphatically not you.

Verily I tell you, neighbors: although it may feel fine to suffer the ban on a tool or a skill that neither you nor anyone you know cares to use, it is not *progress* you are getting this way; it is the very opposite. For when some tools are deemed to be too powerful and too dangerous to be left in your hands, the same fallacy will come for your actual favorite tools, and sooner than you think. The folks inclined to listen to your explanations of why your tools are not evil will be too few and far between.

Knowledge is power, "Scientia potentia est." Power, by definition, is dangerous and can be misused. When the possibility of misuse gets to be enough grounds for banning a technology to the public, it's only a matter of time till *you* are deemed unworthy to wield the power of knowledge without permission. Good luck with hoping that the bureaucracy set up to manage these permissions will be sympathetic towards your interests.

And then, of course, the well-meaning community leaders, lawmakers, and officials will wonder why people's interest in their approved version of STEM is lacking, despite all the glossy pictures of happy kids and smiling adult models doing something vaguely scientific against the background of some generic lab equipment. It doesn't really take long for kids to learn that looking for potentia in scientia means trouble; and who cares for scientia that is not potentia?

Open a newspaper, neighbors, and you will see a lot of folks calling each other "anti-science," as one of the worst possible pejoratives. Yet I wonder: what harms science more than banning its basic technological artifacts from common use, be they mechanical, chemical, electronic, or even mathematical?[5] And, should it come to calling the shots on banning things, would you rather have the people who proclaim the importance of science but have zero interest in tinkering with its actual artifacts, or the actual tinkerers who obsessively fix cars, hand-load ammo, or write programs?

The world has become a much stranger place since the time when our classic tales of logic, science, and technology were written. We will yet have to explain again and again that doctors don't cause epidemics,[6] that engineers don't cause murder or terrorism; and that hackers do not cause computer crime.

Yet through all of this, may we remember to keep building our own bird feeders, and to let our neighbors build theirs, even when we disapprove of theirs just as they might disapprove of ours. For this is the only way for progress to happen: in freedom and by regular, non-special people making risky things that have power and learning to make them better. Thus and only thus do the tall tales of science and technology come true. Amen.

[5] As is the case with the recent government initiatives in the ever so science-friendly states of New York and California that aimed to make it a crime to sell a well-encrypted smartphone.

[6] A pinboard in my doctor's office now sports an official memo from a "Department of Public Health" that knows better than my doctor how to treat his patients. It mentions an opioid epidemic apparently caused by doctors. Consider this the next time you feel inclined to scoff at your ancestors' unenlightened notion that doctors were to blame for the plagues.

17:04 Sniffing BTLE with the Micro:Bit

by Damien Cauquil

Howdy y'all!

It's well known that sniffing Bluetooth Low Energy communications is a pain in the bottom, unless you have specialty tools like the Ubertooth One and its competitors. During my exploration of the BBC Micro:Bit, I discovered the very interesting fact that it may be used to sniff BLE communications.

The BBC Micro:Bit is a small device based on a nRF51822 transceiver made by Nordic Semiconductor, with a 5×5 LED screen and two buttons that can be powered by two AAA batteries. The nRF51822 is able to communicate over multiple protocols: Enhanced ShockBurst (ESB), ShockBurst (SB), GZLL, and Bluetooth Low Energy (BLE).

Nordic Semiconductor provides its own implementation of a Bluetooth Low Energy stack, released in what they call a SoftDevice and a well-known closed-source sniffing firmware used in Adafruit's BlueFriend LE sniffer for instance. That doesn't help that much, as this firmware relies on BLE connection requests to start following a specific connection, and not on packets exchanged between two devices in an existing connection. So, I found no way to cheaply sniff an existing BLE connection.

In this short article, I'll describe how to implement a Bluetooth Low Energy sniffer as software on the BBC Micro:Bit that can follow pre-existing connection despite channel hopping. In cases where channel remapping is in use, it can sniff connections on which even the Ubertooth currently fails.

The Goodspeed Way of Sniffing

The Micro:Bit being built upon a nRF51822, it ignited a sparkle in my mind as I remembered the hack found by our great neighbor Travis Goodspeed who managed to turn another Nordic Semiconductor transceiver (nRF24L01+) into a sniffer.[7] I was wondering if by any chance this nRF51822 would have been prone to the same error, and therefore could be turned into a BLE sniffer.

It took me hours to figure out how to reproduce this exploit on this chip, but in fact it works exactly the same way as described in Travis' paper. Since the nRF51822 is a lot different than the nRF24L01+ (as it includes its own CPU rather being driven by a SPI bus), we must change multiple parameters in order to sniff BLE packets over the air.

First, we need to enable the processor high frequency clock because it is required before enabling the RADIO module of the nRF51822. This is done with the following code.

```
NRF_CLOCK->EVENTS_HFCLKSTARTED = 0;
NRF_CLOCK->TASKS_HFCLKSTART = 1;
while (NRF_CLOCK->EVENTS_HFCLKSTARTED == 0);
```

Then, we must specify the mode, addresses, power and frequency our nRF51822 will be tuned to.

```
/* Max power. */
NRF_RADIO->TXPOWER = (
  RADIO_TXPOWER_TXPOWER_0dBm
  << RADIO_TXPOWER_TXPOWER_Pos);

/* Setting addresses. */
NRF_RADIO->TXADDRESS = 0;
NRF_RADIO->RXADDRESSES = 1;

/* BLE channels are not contiguous, so you
   need to convert them into frequency
   offset. */
NRF_RADIO->FREQUENCY =
  channel_to_freq(channel);

/* Set BLE data rate. */
NRF_RADIO->MODE = (RADIO_MODE_MODE_Ble_1Mbit
                   << RADIO_MODE_MODE_Pos);

/* Set the base address. */
NRF_RADIO->BASE0 = 0x00000000;
NRF_RADIO->PREFIX0 = 0xAA; // preamble
```

The trick here, as described in Travis' paper, is to use an address length of two bytes instead of the five bytes expected by the chip. The address length is stored in a configuration register called `PCNF0`, along with other extra parameters. The `PCNF0` and `PCNF1` registers define the way the nRF51822 will behave: its endianness, the expected payload size, the address size and much more documented in the nRF51 Series Reference Manual.[8]

The following lines of code configure the nRF51822 to use a two-byte address, big-endian with a maximum payload size of 10 bytes.

[7] `unzip pocorgtfo17.pdf promiscuousnrf24l01.pdf # Promiscuity is the nRF24L01+'s Duty`

[8] `unzip pocorgtfo17.pdf nrf51.pdf`