What I've Learned So Far...

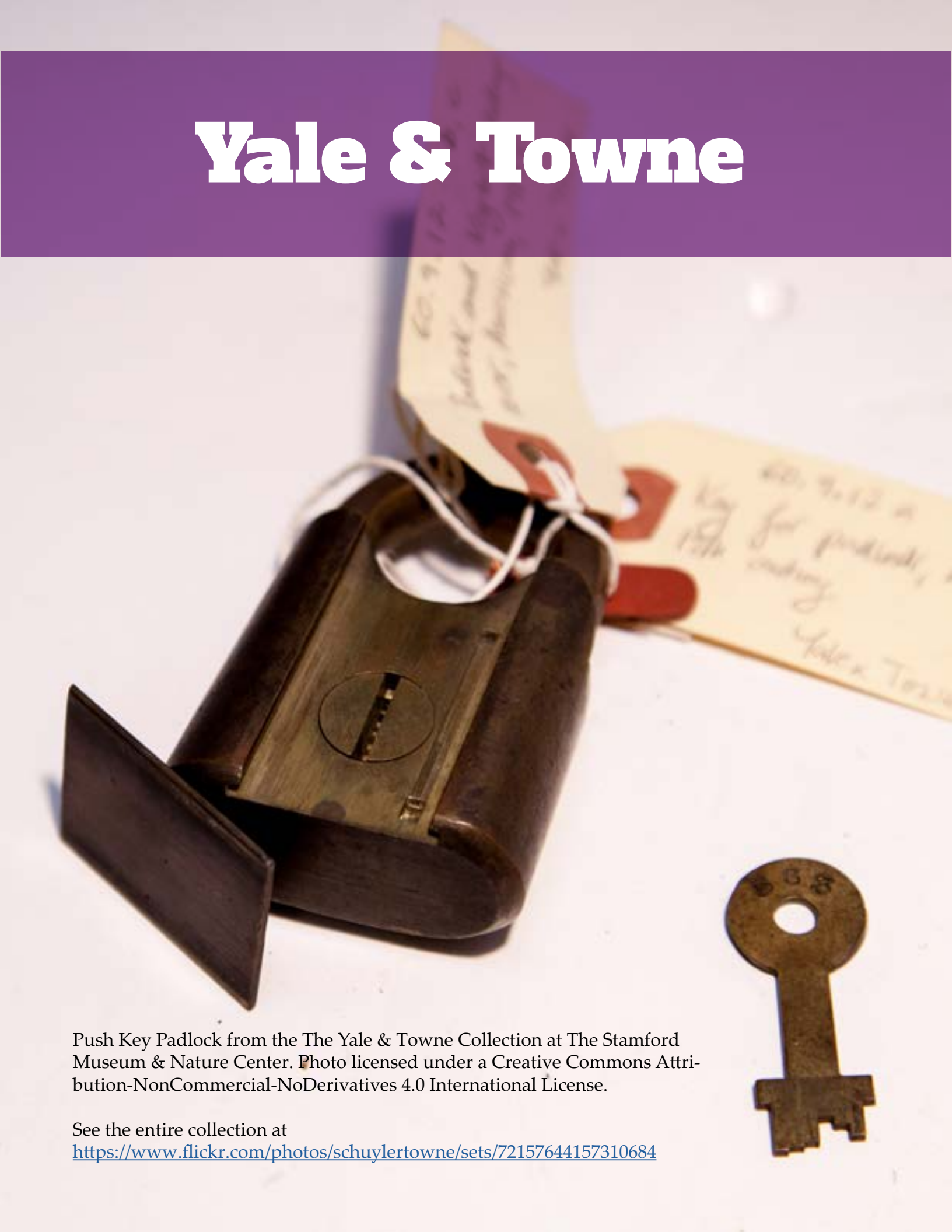
A collection of research notes, unfinished essays, clever ideas, terrible ideas, and just about everything I've wondered about locks, security, and culture.

The goal of this collection is to give you an idea of what I know, what I'm trying to understand, and what I hope to learn about locks, and how mechanical security has affected culture. Purely for budget considerations, I'm going to have to leave some of my output out of this volume, but anything I leave out will be readily available somewhere online, and you can check the resources in the back to find my videos, talks, blog posts, papers, etc. While some of that material has made it in here, I have tried to focus on giving you a look at the work that has never seen the light of day, the research that haunts me, and some of the big questions I'm hoping to find answers to.

Some of it will be sternly academic, some will be passion projects that may never find a conclusion, and some will just be fun little projects I've worked on, like a tiny bit of lock fiction.

I hope you enjoy this glimpse into my chaotic, but always enthusiastic passion.

Yale & Towne



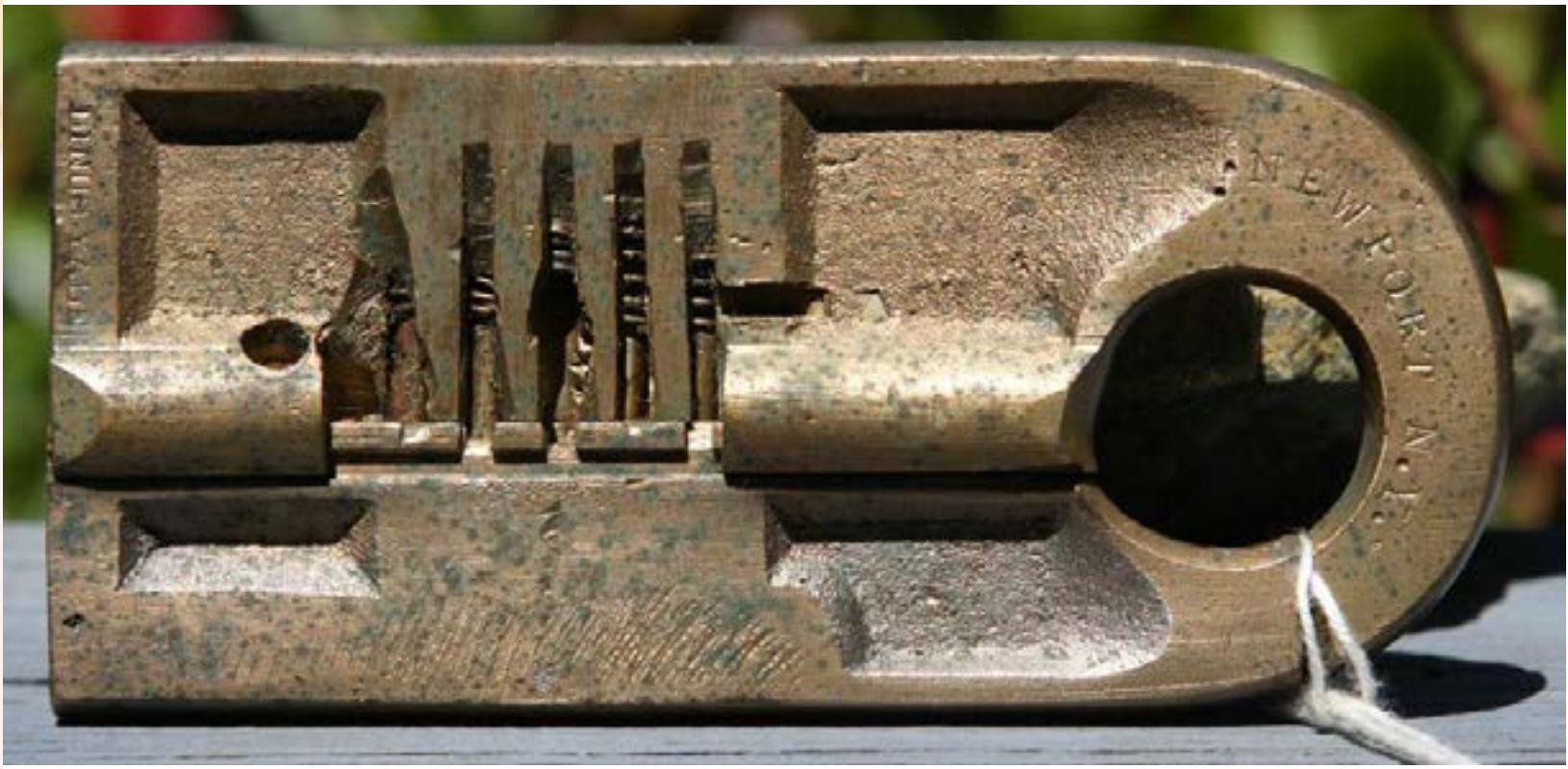
Push Key Padlock from the The Yale & Towne Collection at The Stamford Museum & Nature Center. Photo licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

See the entire collection at
https://www.flickr.com/photos/schuylertowne/sets/72157644157310684

"Few self-respecting professional "inventors" have felt their mission to be fulfilled until they have "invented" a lock of some kind. Apparently there is a fascination in the subject which they cannot resist, however complete their ignorance of the past achievements and present development of the art, and so each incontinently proceeds to "invent" things which, while new to his untutored mind, are usually already well-known, occasionally in successful use, but more frequently long since consigned to the limbo of useless and discarded schemes."

—Henry Robinson Towne, Locks and Builders Hardware: A Hand Book for Architects, 1904

My interest in Yale locks started when I first discovered that the co-founder was Henry Robinson Towne. I promptly called my father to ask "Is he one of ours?" Since then I've determined that Cousin Henry's family branched off from my own a dozen or so generations ago, so the connection is definitely tenuous. Still, I had been picking for a couple of years at that point, so to find out that there was a familial connection, however slight, to one of the most important lock manufacturers in the world was absolutely astounding to me. I instantly felt an odd sense of ownership or pride. The more I learned about Henry and Linus Yale, the more fascinated I was not only with their mutual roles in bringing the most popular lock in the world to market, but also by how the story of Yale seems to tell the story of the whole world of mechanical security over the last 150 years. In the following pages I'll share with you some of my favorite quotes, such as the above, some exciting research into a missing lock collection that has been recently rediscovered, and some notes on the Yale factory general strike.



Linus Yale Sr's original Patent Model for the first pin tumbler lock. From the Patent Model Collection of Mr. & Mrs. O. Rundle Gilbert. Recently up for sale on eBay, though it received no bids.

It is routinely suggested that Linus Yale Jr. went into business with his father, however, Jr's own statements and pamphlets suggests otherwise. We do know that he was a painter with some legitimate talent, and the connection between his father's work and his own is blatantly obvious, but when it came to business, they definitely went their separate ways. Also, it is generally assumed that Jr's lock replaced Sr's, but there was a long stretch of time that both were being produced and sold in competition with one another.

> "Having heard that the *Bacon Lock* is presented to the public by interested parties, as *the Yale Lock*, with the evident intention of selling it, through the reputation our Mr. Linus Yale, Jr. has obtained, by picking the Day and Newell, or Hobbs, and other locks, it is due to ourselves to make the following statement. The Bacon Pin Lock was invented and patented, many years since, by Mr. Linus Yale, Sen., the father of our Mr. Linus Yale, Jr., who sold the patent to Mr. Bacon of Connecticut, by whom the lock is now manufactured. The Lock is of an entirely different principle from any we make, and has been repeatedly picked, both in England and the United States. It is proper to state that neither Mr. Linus Yale, Sen., nor Mr. Bacon, has any connection with our firm."
>
> —*Linus Yale Jr. A Dissertation on Locks and Lockpicking, 1856*

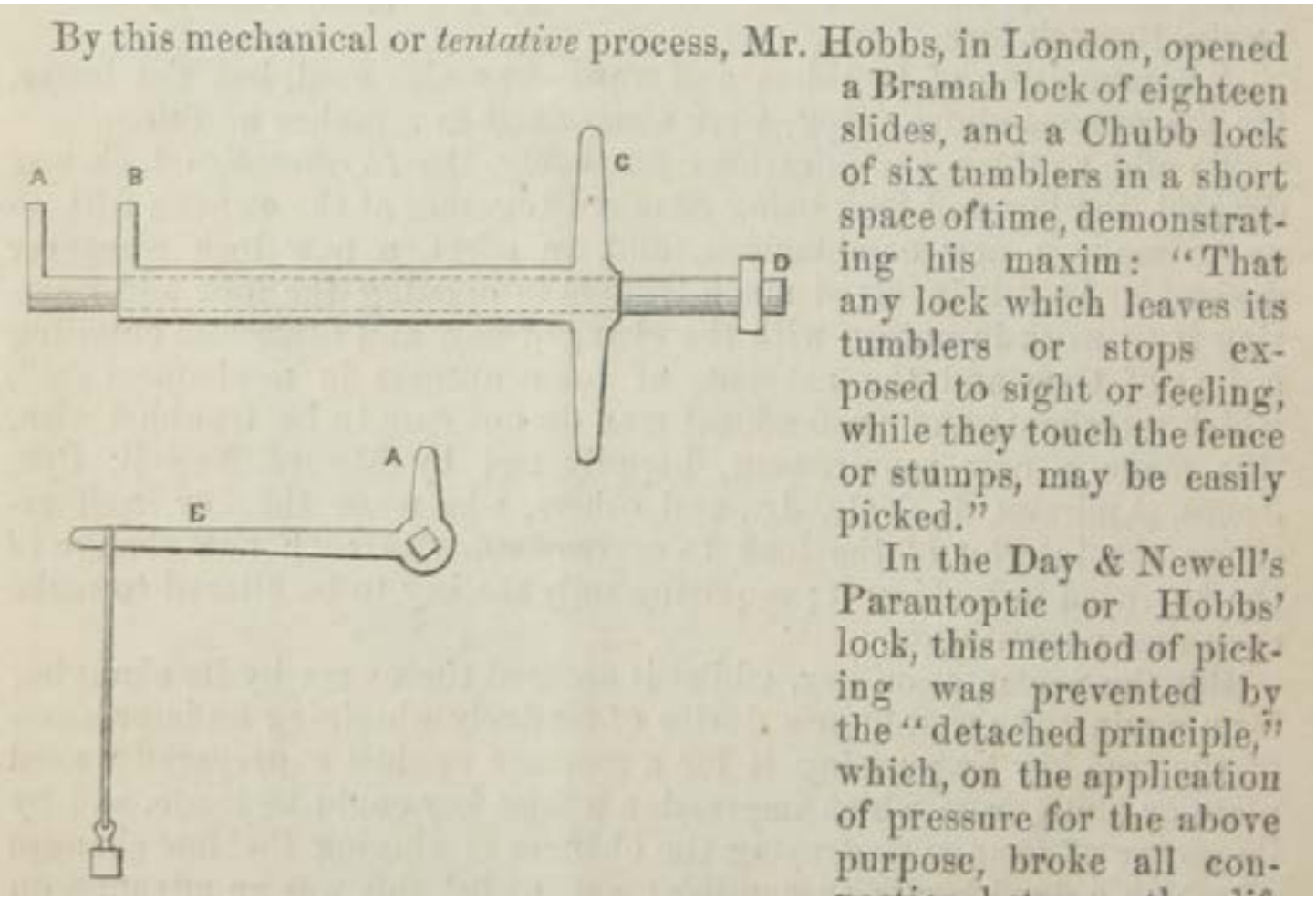
The pamphlet I quote has this amazing subtitle:

> *"...and the Principles of Burglar Proofing: Showing the Advantages Attending the Use of the Magic Infallible Bank Lock, the Infallible Safe Lock, and the Patent Door Lock. Invented by Linus Yale, Jr., (Late of Newport, N.Y.) and His Patent Chilled Iron Burglar-Proof Bank Doors, Vaults, and Safes, Which are Adopted by the U.S. Treasury Department for All the New Mints, Custom-Houses, and Sub-Treasuries in the United States."*

Yale may have been the worst writer of the various locksmiths, engineers and observers during the decade that followed the Great Lock Controversy. Here he gives an invigorating account of the nature of security engineering, and finishes with a shockingly tone deaf declaration:

> "From richest to poorest, all depend upon the skill of the locksmith to secure to them the fruits of their toil; and as a necessary consequence, few inventions have been so severely tried as this branch of mechanism. From time to time, as the cupidity of the robber has caused former inventions to be ranked among exploded ideas of the past, so there has been fresh progress, and fresh skill applied to counteract his efforts; each effort being anew marked with failure, and again and again new improvements have been presented to the public, alike in their turn to share the fate of their predecessors...difficulties and obstacles, instead of daunting, have only stimulated new effort, and as the latest result, we are now able to say "Eureka"—we have found it; and now offer to the public full security against the ravages of thieves and fire."
>
> —*Linus Yale Jr. A Dissertation on Locks and Lockpicking, 1856*

Despite the effusive, tone deaf writing, Linus Yale Jr. definitely knew what he was talking about when it came to locks. The section on lockpicking offers both clear descriptions and nice illustrations of exactly how the locks of the day had been picked.



By this mechanical or *tentative* process, Mr. Hobbs, in London, opened a Bramah lock of eighteen slides, and a Chubb lock of six tumblers in a short space of time, demonstrating his maxim: "That any lock which leaves its tumblers or stops exposed to sight or feeling, while they touch the fence or stumps, may be easily picked."

In the Day & Newell's Parautoptic or Hobbs' lock, this method of picking was prevented by the "detached principle," which, on the application of pressure for the above purpose, broke all con-

Illustration & partial description of Hobb's 2-in-1 tool and method of attack against Chubb's Detector lock.

It's a great read, especially as it predates the application of the "tentative method" of lockpicking to Yale's own pin tumbler locks. As a historical document, it's this perfect example of the extraordinary dominance of the tentative method against an industry that was constantly trying to outwit it. No matter how you protected against the tools and techniques of your time, someone would discover a way to adapt the techniques to new tools and prove your declarations of perfect security to be false.

Within a year or two of the publication of his pamphlet, Yale would have come to the same conclusion that his contemporaries had; any lock that takes a key can be picked. Some said this as early as the 1830s, but by the 1860s the most important figures in the industry had agreed about the death of perfect security.

Sidebar: Tentative Method

The tentative method is neat! Both neat in concept and linguistically. It appears to be borrowed from a description of scientific methods of experimentation, "a tentative process" of failure and iteration, which is an awesome way to think of picking a lock.

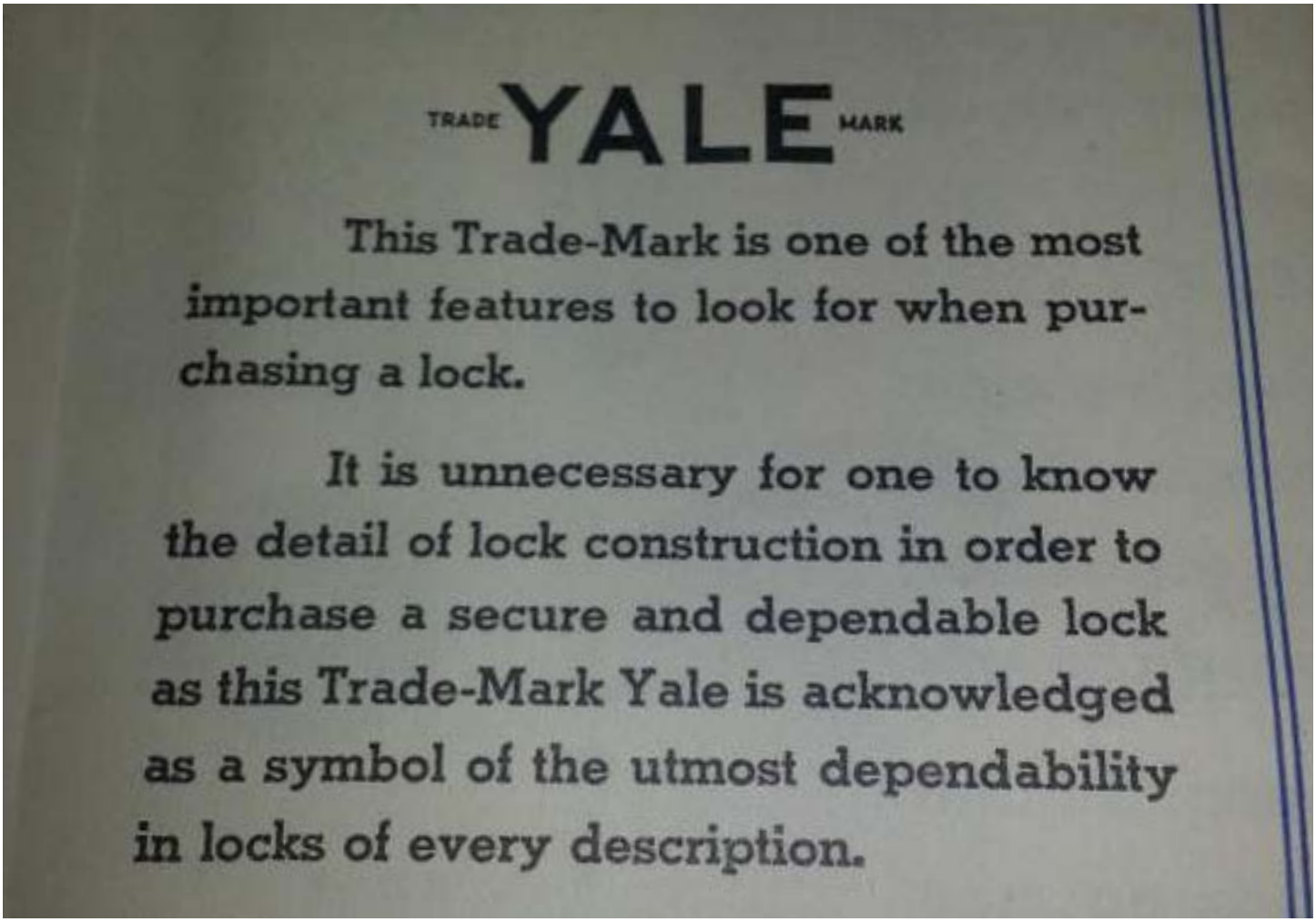
In lockpicking it refers to applying some manner of pressure to the tumblers in the lock, then manipulating those tumblers until they come into alignment. Remarkably, though this was first applied to early lever locks in the late 18th century, the basic concept has succeeded in opening pin, wafer, and slider locks. Even disc detainer locks, first introduced 120 years *after* the discovery of the tentative method, were conquered by it.

Unfortunately, Linus Yale Jr. died very soon after entering into business with Henry Robinson Towne in 1868. Towne, for his part, was both clever mechanically, and about the process of manufacturing. He also had a good head for marketing and the importance of brand identity. Under his leadership, Yale's public image was cemented, though in their literature you could see the shifting ideas of how to sell security in a post Lock Controversy age.

Prior to the controversy locks were frequently advertised by directly comparing themselves against their competitors, and the logical conclusion of public contests and even more public wars of words in the newspapers of the day, followed. While the mechanisms being advertised were often reviewed in depth by engineering societies, the public generally had only a surface knowledge of how they worked.

Once Hobbs had opened the best British locks, however, public interest & knowledge of the mechanisms that kept them safe increased dramatically as both the makers themselves disseminated this information more publicly, and the popular press constantly reported on new developments. Those advertising locks were all but forced to describe the principle of operation in order to convince clients like banks and shop keepers that their lock would restore them to a secure condition.

For their part, Yale went a long way toward offering detailed explanations of how their locks worked, even admitting in their sales literature that their locks could be picked, but suggesting that their merits outweighed that risk. However, as they headed into the 20th century, they began to solidify their marketing around a single idea. That consumers should simply look for the name "Yale" and be satisfied that they were getting the best quality product, whether they understood it or not.



The Yale & Towne produced book "The History of the Trade-Mark: Yale"paints a fascinating picture of an early battle in the history of Branding and Trade Marks. Much like Kleenex or Singer Sewing machines, Yale found their brand name being used generically. Everyone was trying to sell "Yale Locks" or "Yale style Locks". It got to the point that people were filing patents using "Yale Locks" as a generic term which was universally understood to mean "Pin Tumbler Locks". A few examples:

> "It is more especially adapted for what is known in the trade as the Yale Lock"
>
> —*Patent US360738 A, filed 1887*

> "...a socalled cylinder or Yale lock"
>
> —*Patent US889977 A, filed 1906*

> "...a safety lock (Yale lock) can be used in connection with..."
>
> —*Patent US1116277 A, filed 1913*

> "The particular kind of lock to which the present invention is applied, is usually called a Yale lock"
>
> —*Patent US2228971 A, filed 1939*

Somewhat ironically, after Linus Yale Jr. had attempted to distance himself from his father quite publicly, Yale & Towne tried to recreate that connection in order to add additional time and legitimacy to their trade mark.

> Linus Yale, senior...had a natural talent for mechanics...which led him later into designing and making bank locks... In 1847 he built, in Newport, N. Y., the substantial stone building, still standing, which ever since has been known locally as the "Yale Lock Shop," In that year also he brought out a "Yale Bank Lock," the first of the long line of locks destined to bear that trade-name, which was a masterpiece of ingenuity and which won lasting repute for the name "Yale" as indicative of origin and high quality.
>
> —*The History of the Trade-Mark: Yale*

Their plan worked. The trade mark Yale did come to be known, around the world, as a mark of quality and security. That brand name was so strong that though the company was bought, reshuffled, and re-prioritized more than once, every iteration has continued to sell pin tumbler locks with the name YALE emblazoned on them.

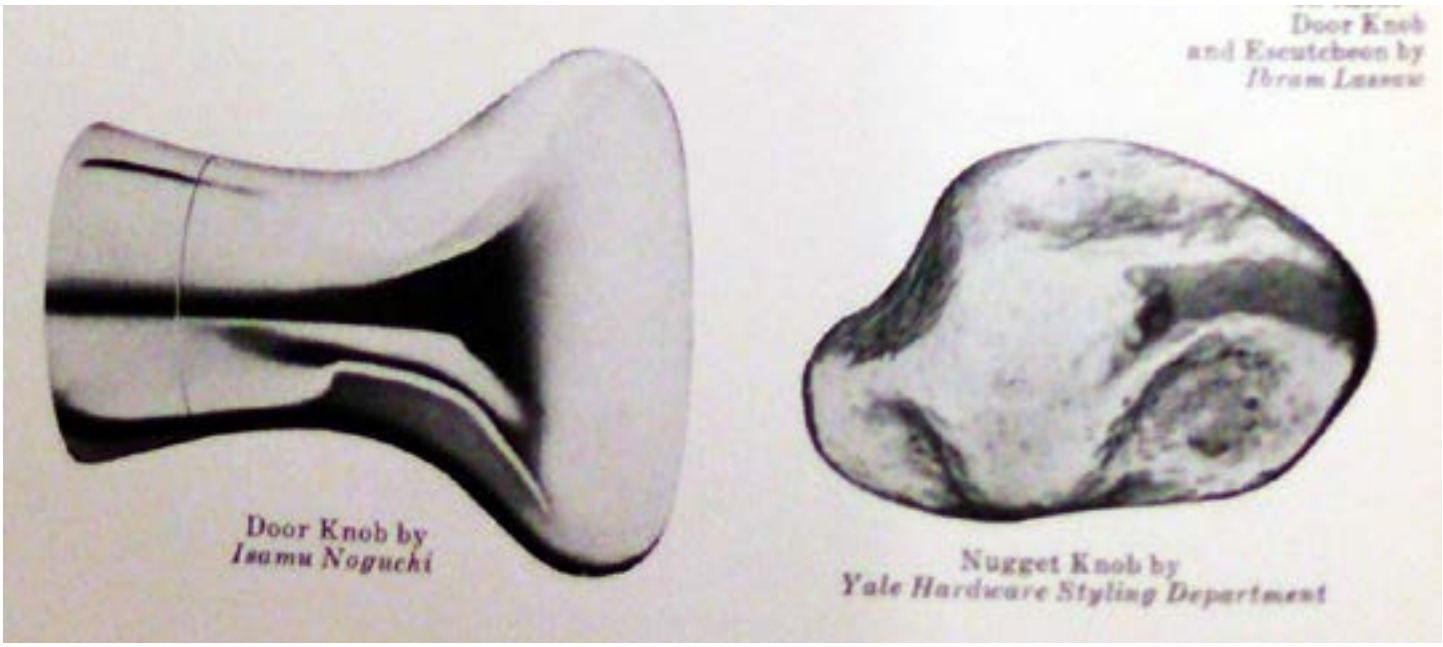
Today Yale has arrived at a bittersweet resting place. Owned by ASSA|Abloy, everything they once were as a security engineering pioneer, while important historically, has been devalued. Merely that brand name Yale, so fiercely established and protected, seems to be worth anything anymore.

Style & Security

In January of 2013, I was attending a conference in Chicago where I met the head of acquisitions for the Museum of Science & Industry. She happened to overhear me talking locks with someone and introduced herself. She told me that the museum had just been approached by a widow who wanted to donate her husband's lock collection, but that they didn't really know what to do with it, or if they should bother. All I knew at the time was that he was an employee of Yale & Towne. Being that I have a very specific interest in Y&T, I put on the best show I could to convince her to acquire the locks. Then, I heard nothing for a year. In January of 2014, I was back in Chicago for the same conference when I received an email saying that the locks had been acquired, and it wasn't just Yale locks, but a huge collection of locks from around the world over the past couple thousand years, and would I like to come unbox them for a small audience.

It was probably the worst talk I've ever given because I was so engrossed in the locks themselves and basically ignoring the attendees. The staff at the MSI had done some early work to establish that this was only 1/3rd of what had been a massive collection assembled by the Yale & Towne company over the course of about 90 years. They knew that another 3rd was held by the Stamford Museum in Stamford, CT, and that the final 3rd was still in private hands, but they were trying to find it.

Since then I've been on the hunt for any and all information I can find. It's been going very well, and I can sketch out a rough picture of what this collection was like in the 1950s. The wife of one of the directors at Y&T was deeply immersed in the modernist art scene and approached her husband about doing a collaborative project with several prominent artists & Y&T. This became the "Style & Security" exhibit which toured the country at art galleries, museums, and universities. It featured the expansive Y&T lock collection, with commentary, and several examples of modernist art relating to locks. In particular, handles & escutcheons sculpted by the likes of Mirko and Fernand Leger.



Then, during Yale & Towne's acquisition by Eaton in 1963, the entire collection was disbanded. The story goes that one third was donated to the Stamford Museum, where it was briefly displayed before being boxed & stored in an attic, and the other two thirds were to be discarded. Thankfully two gentlemen at the company instead decided to split the remaining thirds between them.

Yolanda Pope, the woman who donated the collection, kindly sat with me for a 2+ hour long interview, during which she told me all about the wonderful life she shared with her husband, Paul Charles Pope. According to Yolanda, Paul was told to "Throw these locks in the river", but hated the thought of them being destroyed or lost, so he brought his third home, where they remained in boxes in the attic for half a century. Yolanda enjoyed decorating Paul's office with a few of the larger pieces, but in general, they just stayed in storage.

We know that Paul was hired in 1858, and that the Stamford Museum received their third of the collection in 1859, which was originally a loan, but was made a permanent gift in 1860. During this time, Paul was a salesman and I don't believe he would have been in a role of enough responsibility to be charged with the destruction of the lock collection, so it doesn't seem likely that the remainder of the collection would have been disposed of at that time. The next obvious event that may have caused the collection to be broken up was the acquisition of Yale & Towne by the Eaton corporation.

In 1963, after 95 years of continuous operation, Yale & Towne was sold. For Eaton, the security division was a secondary interest. A point they proved by re-selling that division only 15 years later. Eaton's purchase came while the Style and Security exhibit was still active, and they brought it to the World's Fair in New York in 1964. I'm guessing that the lock collection was probably turned over to Charles Pope's care sometime soon after the acquisition. At the moment, I don't even believe that any of Charles' portion of the collection were displayed at the World's Fair.

Working with colleagues at the MSI and Stamford museums, we've been able to establish a rough time line of events related to this collection:

1882 - Art Hardware Division

As early as 1882, Yale established an "Art Hardware Division", later known as the "Yale Hardware Styling Department". The goal of this department was described as

> "The development of designs conforming to the true principles of art."
> —*Fifty Years of a Successful Industry*

From very early on in the history of the company, Yale & Towne decided to focus on the artistry of their hardware right alongside utility. This was ultimately fully realized in the Style & Security tour.

1954 - Design initiative to create a 'contemporary' line of hardware

While Y&T's catalogs are a testament to their ongoing commitment to beauty, in the 1950s the renamed Yale Hardware Styling Department set to work on a new initiative to create contemporary hardware drawing on new forms in art and architecture.

1954 - Acquisition of Gillian W. B. Bailey collection.

In the same year, the company acquired the Gillian W. B. Bailey lock collection. Hers was an amazing, centuries-spanning collection of locks, keys, and locksmithing equipment. This acquisition was celebrated.

> "The Yale Antique Lock Collection, with the addition of the Gillian W. B. Bailey Collection, is believed to represent the largest and most important collection of historic locks in the world."

1956 - 'New Forms in Door Ornamentation' kicks off in NYC

Two years after the start of the contemporary hardware initiative, the fruits of the Hardware Styling Department were on display alongside sculptural knobs, escutcheons, and door plaques designed by some of the most accomplished modern artists of the day. Altogether, they toured around the country at art galleries and museums.

1958 - Mr. Pope joins Yale & Towne as a Salesman

1959 - Large portion of beautiful pieces gifted to Stamford

1960 - Gift made permanent

1960 - Style & Security exhibit/tour kicks off

Following up on the success of the New Forms in Door Ornamentation exhibit, the Style and Security exhibition, which combined the forward looking art pieces with displays of "4000 years of the history of locks". We know they were requested a few specific pieces, including a large ornamental key used to advertise a locksmith's shop, be returned from the Stamford Museum.

1962 - American Federation of Arts continues to display Style & Security

Just a data point, but we have records of the Style & Security exhibit being open and available to the public through 1962.

1963 - Bought by Eaton

1964/65 - Displayed "Style & Security" at NY World's Fair

Next up is trying to find the art. We know that the Smithsonian has the records of the American Federation of the Arts from this time period, so hopefully somewhere in there will be a lead on what happened to the collection after the exhibition ended.

And finally, we want to find the remaining locks missing from the collection. The amazing Yolanda Pope has offered us a lead, but it looks like the collection may have been broken up into private hands at some point. If I can find any trace I'll be thrilled.

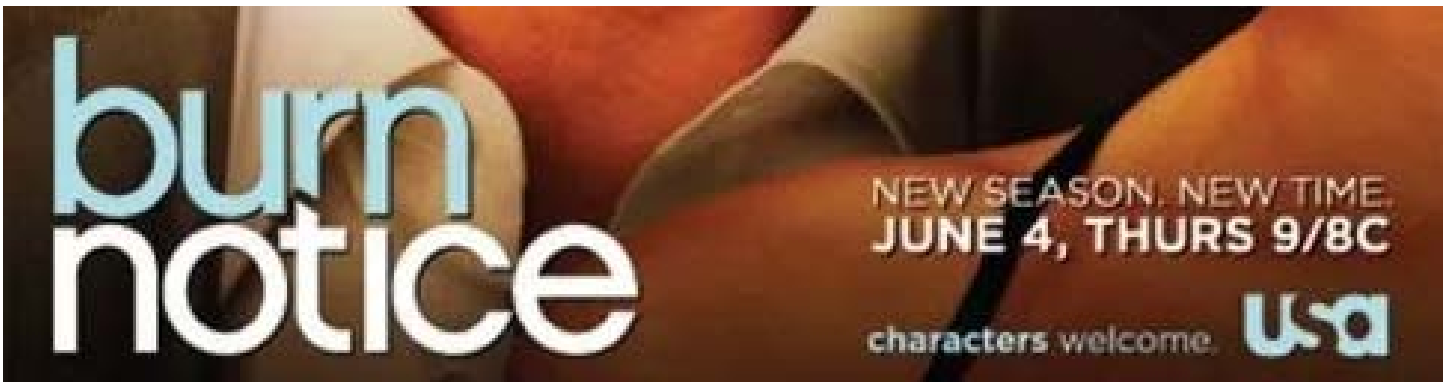
Entry in Popular Media

As soon as you reach some level of expertise in any niche field, it becomes impossible to not notice when people get it wrong in films, television shows, books and video games. Lockpicking is no different. The first time it really took me out of the moment was when I tried to binge-watch Dexter. I found myself tweeting frantically at the producers to no effect, which, in retrospect, got a little ridiculous. But! It also started me on a journey to detail various instances of locks and lockpicking in film and television, eventually expanding to books and video games as well.

Initially I just put up a Google Survey and asked people to bookmark it so any time they were streaming something they could send me the details if they saw someone open a lock. Over a couple years this gathered dozens and dozens of examples, and for my part, I actually managed to line up a couple consulting gigs. First, I spoke about entry techniques & lock forensics for an audience of mystery authors at the New England Crime Bake. As a result of that talk I've had the opportunity to provide technical expertise to a small group of remarkable authors who care deeply about authenticity.

Later I wound up working on an episode of a short-lived History Channel show called Sliced, helping them source & explain a number of different locks from safe deposit boxes to high security door locks. As people sent me more and more examples, and I got to see various media professionals work with the idea of locks and lockpicking I started to understand something. Lockpicking can be more than a moment, it can be used as a storytelling element.

With all of that said, let's look at 2 of my favorite, and two of the worst, uses of locks and lockpicking I've come across.



Few shows deal as much with locks and security as Burn Notice, so don't think this is the only time they'll get mentioned on this blog. In general? They don't do a great job when it comes time to pick a lock, but there are exceptions. One of the more compelling parts of the show is that the main character, Michael Weston, frequently narrates the details of various tools and techniques of spy craft. Anything his narration covers appears to be decently researched and well executed. Of course...that doesn't mean there won't be hiccups along the way.

In the third season of the show, they briefly turned their attention to lock bumping. It was the topic of one of Michael's instructional monologues, and eventually used to get into a restricted area of an office building he and his team were infiltrating. What is especially good about the episode is that the visuals actually go to a level of cleverness and accuracy that the narration doesn't bother explaining. Before they even launch into making a bump key, they set the piece up by having Michael ask a secretary in the building for a key to the bathroom, which she hands over happily.

Cut to Michael in his house/workshop, having walked out with the bathroom key. The narration kicks in at this point, and while they oversimplify and use some strange terminology, it's not the worst.

"All you need to beat a modern tumbler lock is a little information and some stone age tools. If you know the basic type of key you need to spoof, pick out a matching blank, file down the valleys to the center ledge and you have a bump key. Apply torque, whack it with anything handy, and you're in."

So, modern "tumbler" lock, should be "pin tumbler" as bumping doesn't work on some of the worlds other "tumbler" locks, and that's because tumbler is the generic word, while pin is the specific one. It's weird that they bothered to keep "tumbler" in there at all without "pin" but whatever...I can let it go. Grudgingly. What is more maddening is the line "file down the valleys to the center ledge." Now, what do they mean by center ledge? I'm not sure, but "lowest depth" would have fit nicely and made a lot more sense. In fact, they do so much right in this scene that I am second guessing if I am the crazy one and center ledge is actually a universally accepted term...that I've never heard.

But I digress! It is actually impressive what is going on visually, and as much grief as I give it, the narration really wasn't the worst. What's very cool is that he borrowed the key to the building, which implies that he's taking advantage of the fact that the keyway will probably be consistent throughout the building (plenty of examples where it wouldn't be, but it's a smart thought when attacking a facility).

And though the narration says that he is just using the key to identify the proper blank, he's actually doing much more than that in the video. There is a quick shot of his tools that reveal a blank key and plenty of files, but what is he's reaching for first? A sharpie! And that's awesome.

Using the sharpie, with the blank key lined up below the bathroom key, he is marking off the spacing of the cuts in the key! Now, you can look that spacing up (google depth & space chart lock), but it's much simpler and quicker to match the spacing to a functional key, and to make a proper bump key, you have to get the spacing just right. This is a great detail that is on screen for less than a second. Good stuff!

Next he files down the blank, and while this really isn't the ideal file to be using, the finished product looks great. That right there looks like a properly cut bump key. I also really like that Michael has built himself a few lock boards that we see scattered around his workshop. They are easy to make and handy to have. Michael's work area throughout this scene looks a bit like my own.

Now, this next bit might be my favorite...

He uses the heel of a dress shoe to test the lock! When we (locksport folk) explain bumping, we often describe some interesting things you can use in place of a bump hammer. One of the ones I always mention is "The heel of a dress shoe" and I learned that from the person who taught me, so it's fun to think of this moment as a subtle hat tip to the locksport community.

Finally, it's time to take this show on the road and carry out the actual attack.

On the lock in the facility, he uses something a bit more consistent than the heel of a shoe - a bump hammer. There are a few on the market, but the majority of them are just a hard piece of plastic attached to a flexible piece of plastic. This allows

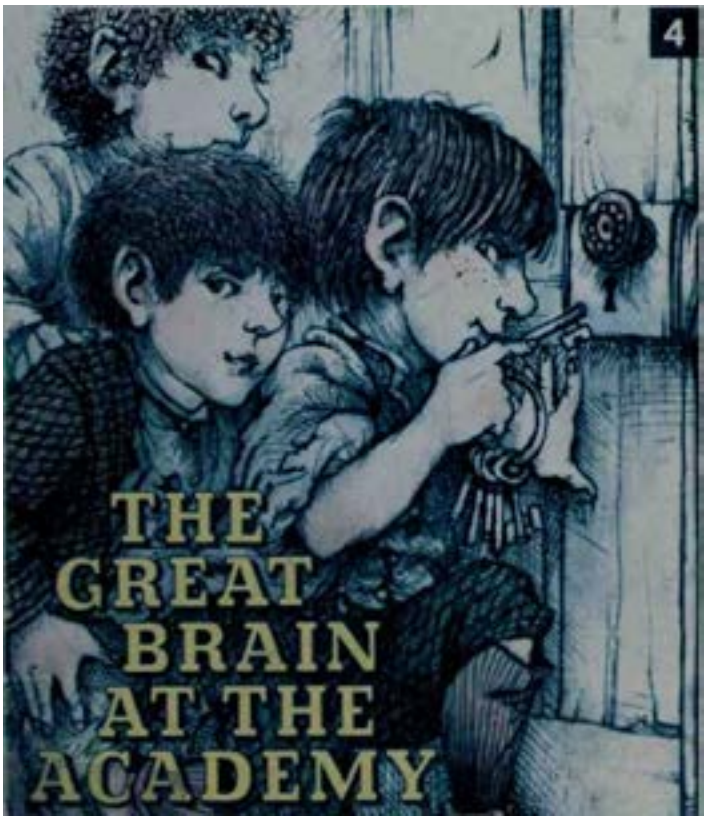
for a lot of energy transfer from the hammer to the lock. It's the right tool for the job and, of course, works the first time. Now, how did they manage that? Did they shoot the sequence over and over until they got it on the first try? Did they get really lucky on the first take? No. They just used the actual key for the lock:

Look close and you'll see that this is not the bump key. Now, as great a job they did with this attack, and while even I can acknowledge that sometimes you need to give up authenticity for the sake of entertainment, there is a simple way to make this attack look more legitimate. Pin the lock to match the bump key. It'll work on the first strike every time!

Want to contribute to this work? I've kept a Google survey up and running for years. Whenever you see something involving a lock or lockpicking in a game, book, movie or TV show, just pull up:

http://lock.gd/n

And you'll be directed to the survey. Feel free to bookmark it for quick response, if you'd like.



The Great Brain at the Academy was one of my favorite books as a kid, long before I knew anything about locks or lockpicking. I loved the whole Great Brain series, but a couple years ago a scene from this specific book popped into my head, and I realized that I had been taught the "Wax Pad Attack" when I was very young. Imagine my excitement when I saw the cover again for the first time in years.

The Great Brain (Tom) has been sent to a very strict boarding school where he quickly gets a reputation for being a trouble maker. The school uses a system of demerits and Tom racks them up with abandon...until he gets a project in his head. When sentenced to clean the bathroom every day for a month, Tom discovered a passage into the attic where he promptly sets up a secret candy store where he resells 5 cent candy bars for 10 cents to the other students. He is making money hand over fist, but runs into a problem. He hasn't gotten in enough trouble to keep his punishment!

> *Tom sure as heck didn't feel like being congratulated. He felt like giving himself a hard kick in the behind for not remembering to get some demerits so he wouldn't lose the washroom job. Without it the Academy Candy Store would be out of business. He had to keep that job.*

Unfortunately for Tom, it wasn't to be. He had to devise a new plan, and in talking to his friends, he started to get an idea.

> *Jerry shook his head sadly. "Good-bye, candy store," he said. "The washroom is the only way to get into the attic."*
>
> *That made Tom's great brain wake up in a hurry. "Wrong," he said. "What about the storeroom on the third floor? I bet there's a trapdoor into the attic from it."*
>
> *"So what?" Jerry asked. The door is always locked. And Father Rodriquez carries the keys on that ring and chain he always has with him."*
>
> *"Maybe not," Tom said. "Remember the ring of keys hanging on the wall in his office? I'll bet they are a duplicate set in case one of the priests needs them when Father Rodriguez isn't there. There is only one way to find out."*

Like a scene out of a heist movie Tom & his 3 friends set up an elaborate system of movements and lookouts and secret knocks to get him access to the keys when the office is empty and no one is within sight of the hall. Tom snags the keys, then the next stage of sneaking gets them to the storeroom. After three failed attempts, the door opens with the 4th key on the ring. With the right key identified, Tom gets down to business...

Tom and Jerry went down to the washroom on the second floor and Tom made an impression of the key in a bar of soap. He wiped the key off carefully before going back to the third floor and hiding the bar of soap under the statue of Saint Francis.

Saint Francis is the patron Saint of merchants, which is right up Tom's alley. Now, while it's cool that he took an impression of the key in a bar of soap, it doesn't lend itself to casting or even a great deal of fidelity in the impression. So, Tom has to carve a key just using the impression as a reference.

Tom met with his three friends at their usual tree in the yard the next afternoon. He had a piece of wood, the bar of soap, and his pocketknife. He sat on the far side of the tree so his three friends could warn him if anybody approached. Tom was an expert whittler and could carve just about anything, but it took him more than an hour to make a wooden key from the impression in the bar of soap. He hid the key under the statue of Saint Francis.

So, we now have a wooden key that has been hand whittled from a soap bar impression. The chances of this key actually working in the lock? Not good.

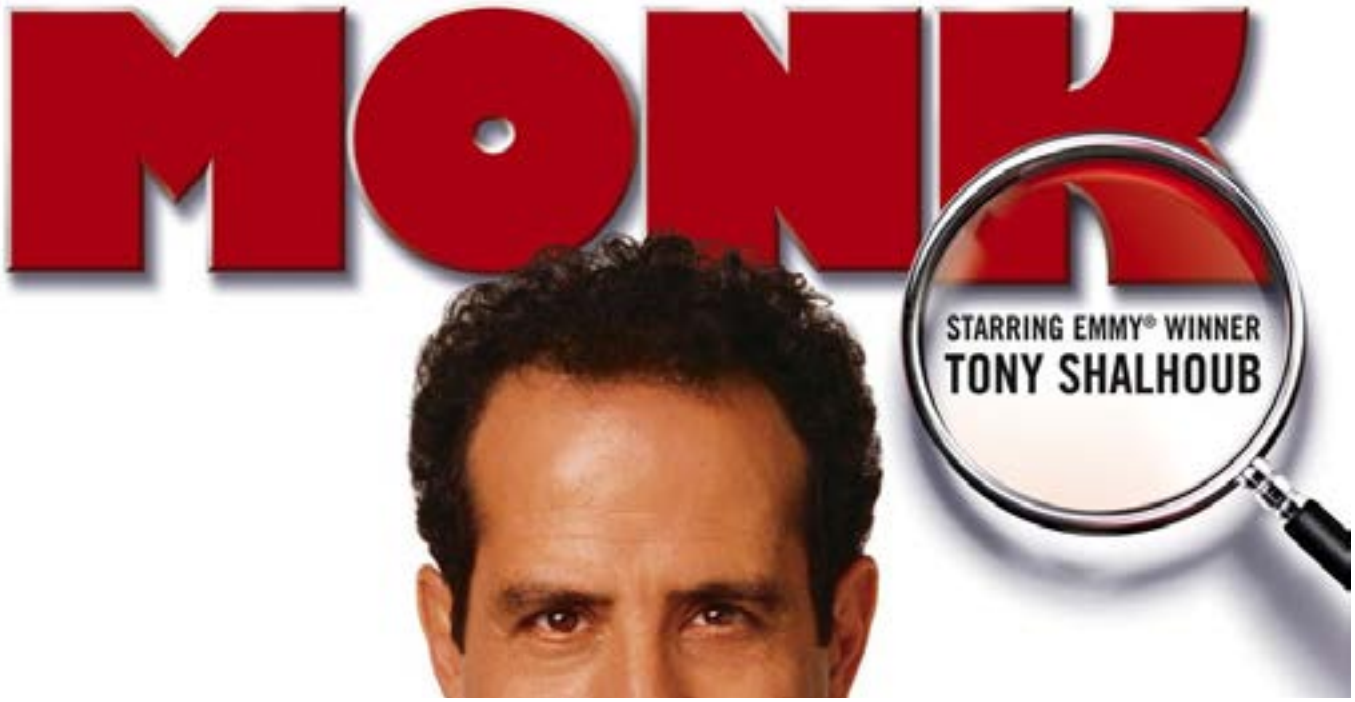
That night he lay awake until all the other boys were asleep. He got a black crayon and his pocketknife and crept into the hallway. He removed the wooden key from under the statue and tried it in the lock of the storeroom door. It didn't work. He then rubbed the black crayon on the key and tried it again. He went into the washroom and turned on the lights. He could tell from the crayon marks that the key had to be carved in two places. He did the carving and once again tried the key in the storeroom lock. It turned halfway and stopped. Again he rubbed the black crayon on it and tried again. He went into the washroom. The crayon marks told him that he had to make the notch on top deeper. He did this and once again tried the key. This time the wooden key opened the lock. Thanks to Tom's great brain the Academy Candy Store was back in business.

This is awesome! Tom has not only done a slick impression in a bar of soap, he actually carried out what is called the Wax Pad Attack. And he did it perfectly!

A warded lock works very simply. If you look at any of the keys on the key ring on the cover of the book you'll see a relatively simple shape. Inside the lock is the negative image of that shape, set in pieces of metal called "wards." By applying wax from the crayon to his makeshift key, Tom makes it possible to see where, exactly, the wards are hitting the key. He then removes wood anywhere he sees missing wax, and tries again. On his second attempt the key goes a bit farther before hitting another ward, which is a great little detail, as wards were spaced throughout the travel area of the key inside warded locks. He again applies wax, gets a new impression and whittles his key down to work perfectly in the lock.

This is hands down the best representation of an entry technique in any fiction book, film, television show, game, etc. that I have seen. And this is a children's book from the 70s! Very cool.

"Mr. Monk Goes to the Bank" is one of the most painful hours I have ever spent with my television. There are a handful of scenes in film and TV that make me wince, but rarely do I sit through an entire episode that hinges on mishandling the opening of a lock.



The Setup:

Someone robs a bank, things don't add up, Monk sees a few sticks in a trash can and sorts it out just in time to get trapped in the vault by the killers.

For a while all hope is lost, until they realize that there is a panel in the vault that could open the door. Unfortunately it is locked by the most secure 4 wheel dial padlock known to man.

Just kidding. It's a dead-simple masterlock padlock that isn't useful for much more than protecting luggage.

The scenes that follow involve Monk & friends being genuinely concerned that they will die. They shoot the lock to no effect and eventually destroy a beloved piece of jewelry owned by Monk's dead wife in the pursuit of "sawing" the lock with a diamond bracelet, which, of course, fails as well. This is both infuriating to watch, and heartbreaking.

Let's put this into context: they were trapped in the vault for several hours, the Monk wiki page estimates 8. There are 10000 possible combinations.

I am sitting on my couch with a very similar lock. I'm going to see how long it takes to dial in 100 combinations, and to be fair I'll to start at 0980 so that I'll have to move every wheel and I'm going to do it at a relatively leisurely pace. Here goes!

1 minute and 34 seconds.

OK, let's extrapolate. There are 10000 possible combinations, and assuming each of the 4 people in the vault are willing to take turns every thousand or so, they should be able to keep up a pretty steady pace. 1 minute, 34 seconds is 94 seconds. 94 seconds multiplied by 100, divided by 60 and then divided by 60 again, gives us a little over 2 and a half hours. And that is ONLY if the actual number is the very last one they try. Adding some reasonable odds to our rough estimate I think it would be very fair to say they could have had it open within 2 hours by just brute forcing the combination.

Even if they had spent the first half hour trying all sorts of wacky solutions, I have to hope that someone would have started dialing all the possible combos before anyone pulled a gun or destroyed one of the last remaining artifacts of Monk's dead wife.

People usually think I'm a being ridiculous when they hear that I had to stop watching Dexter because of their mishandling of locks, or that I was taken completely out of the moment by the lack of a tension wrench in an important scene in a movie, but this most egregious example seems to be a shared experience. Looking at the "goofs" section of the Wiki page for this episode you'll see this and other lock-related errors called out with sentences that start "It would ruin the plot, but..."

Better to fix your plot than ruin my night.

I really liked the closer. I feel like I should put that right here at the top, because throughout the series they handle locks and lockpicking terribly, and things kind of came to a head for me in the 6th season. In the end I decided that shows like this, portraying entry as they do, are genuinely contributing to a decline in the ability of American consumers to understand and assess their own security devices and risks.

Which pisses me off.

On many occasions, Brenda Lee Johnson, the protagonist and Deputy Chief of the Major Crimes division of the LAPD, has picked locks to get into homes and business. This is generally done with a disregard for the basics. Sometimes they successfully employ both a tension wrench a lockpick, which

is nice, but the plug of the lock never rotates, and the duration of picking attempts always trivializes the moment of entry. However, that's par for the course. That hand-waving of entry is what I have come to expect, and I've relaxed enough that I can generally just note it and move on. Then, in Season 6, Episode 2, I hit a wall.

The episode, "Help Wanted" is a case where multiple Nannies are getting murdered. In the course of the investigation, Brenda decides to pick her way into a house while being effectively audited by Internal Affairs. Some glib line is offered to excuse her behavior, and the officers walk into a quiet apartment.

Only to find a murder victim in a back room. As they try to understand what could have happened, someone says the key phrase that you'll hear in any police procedural you watch.

> *"No signs of forced entry. The victim must have known their attacker."*

Now, just remember, only moments ago, Brenda picked her way into this place, and yet, without any investigation of the lock or door hardware, they have decided that there was no possible way someone could have gotten in here unless the victim knew them. Painful.

As you watch other crime-themed shows, look out for that dichotomy. The casual expertise of the investigator and the assumed lack of ability of criminal trespass. It is a constant refrain, and knowing that very few locks are ever forensically investigated and that most people assume that no criminal would pick a lock, I think that one, constantly repeated, lazy line may be causing actual harm.

Rough Ideas & Early Research

I wasn't sure what to call this section. This is definitely a rougher collection of ideas, conversations and notes than some of what we've covered so far, but that's exactly the sort of thing I want to include in this collection. I'll try to roughly organize the ideas, but forgive me if there is some disorder.

Crime Data, Insurance Standards, Public Perceptions of Security, and Media Influence:

I've been trying to understand a few things for years, and recently realized that they are all likely connected, or at least exerting influence on one another. The four questions have been:

1. Why don't American insurance companies offer incentives for higher quality locks?
2. Why don't any of the US standards organizations test for non-destructive entry?
3. What effect, if any, do popular media portrayals of entry have on public security?
4. Why aren't locks routinely, or even occasionally, forensically investigated.

In talking through these questions separately with friends and colleagues, I started to understand that the answer to each of them involved the others. Here's an excerpt from one of those conversations:

> *Me: The available crime data does not reflect any particular reality as forensics are so rarely employed. Lacking any substantive information on the nature of entry, the incentive to improve or at least use existing improvements in locks is very low, for both consumer & manufacturer.*
>
> *No incentive for improvement makes for no incentive for receiving high marks in testing, which makes for no incentive to create a thoughtful testing standard, which makes for no usable data to create insurance incentives, which gives consumers no financial incentive to invest in better locks, which perpetuates the use of locks that can be easily compromised, which themselves aren't forensically investigated.*
>
> *And so on. It's hard to just toss a wrench in there and correct one part of the cycle*
>
> *Adam S: Right. You'd probably have to do two at once. Get a holistic lock security standard created and get insurance buy in at the same time.*
>
> *Me: Yes. Or somehow reveal the use of entry techniques that are unreported by police, while providing high quality low cost options to consumers.*

Other friends who's opinions I respect have told me explicitly that it doesn't actually matter if 1) anyone is picking locks in burglaries, 2) the general public in the US uses quality locks. Though the matters of insurance standards and media portrayals of entry remain interesting to them. I get the argument, and while I actually don't have a strong answer to #2, I do think real data about methods of criminal entry remains important.

I routinely have people tell me that “thieves don’t pick locks”. However, when I try to find out why the person saying so believes that, they will inevitably fall back on either anecdotal evidence, which is frankly worthless, or FBI Crime Data, which unfortunately, in the case of non-destructive entry, isn’t much better than worthless. Locks are rarely subject to forensic investigation. I’m not saying that there is an unchecked surreptitious entry problem in this country. What I am saying is that I have no idea how often locks get picked, and no data to back up any conclusion. Here’s the data we do have:

- According to the FBI’s 2012 Uniform Crime Report, ~2,103,787 attempted burglaries were reported.
- Of those, 59.7% were successful forcible entries,
- 33.9% were “unlawful entries” not involving force,
- and 6.3% were attempted forcible entries.
- Of those reported burglaries, only 12.7% make it to a prosecution.
- We also know, from numerous studies of populations across the country, that one third to one half of burglaries go un-reported.

Erring on the side of caution, let’s up the FBI’s numbers by one third to account for unreported burglaries, and estimate that there were approximately 2.8 million burglaries in 2012. Of those, we can estimate that one third were non-destructive entry. That leaves us with ~930,000 non-destructive entries in 2012 alone. Again, I’m not suggesting that all of those were lockpicking, many will be due to unlocked doors, open windows, or other oversights, but I have to believe that some of the locks, any of them, were manipulated open.

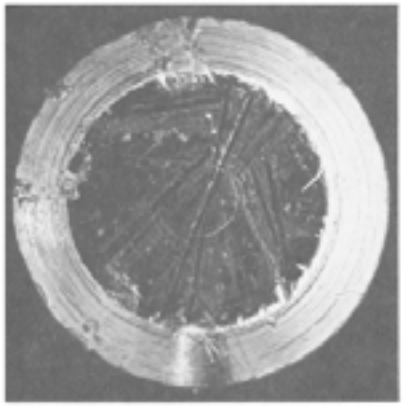


FIG. 5—*Kwikset pin tumbler from a lock cylinder that had been picked with a hook pick. Pin diameter is 2.92 mm (0.115 in.).*

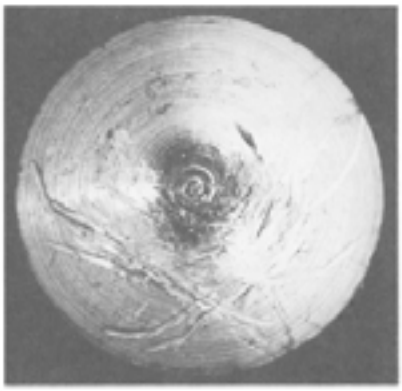


FIG. 6—*Yale pin tumbler from a lock cylinder that had been picked with a hook pick. Pin diameter is 2.92 mm (0.115 in.).*

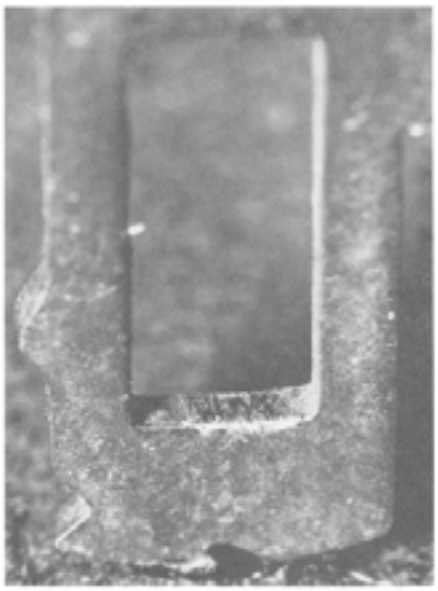


FIG. 7—*Five disc tumbler from a lock cylinder that had been picked with a rake pick. Tumbler width is 4.83 mm (0.191 in.) and thickness is 0.73 mm (0.028 in.).*

tumbler lock cylinder. This was surprising, since the bounce pick is specifically designed to pick the pin tumbler lock.

Conclusion

If a lock is suspected of having been picked, an examination could reveal if an instrument other than a key had been inserted into the cylinder plug of the lock. The examiner could state an opinion as to whether an attempt had been made to pick the lock, whether or not the attempt might have been successful, and the general type of pick used. If a tool is located that is suspected of being used in an attempt to pick a given lock, the examiner may be able to state an opinion as to whether or not the suspect tool could have been used in the given lock. With this information, evidence from the scene, and the facts of the case, the investigator should be able to determine whether the lock had been neutralized with picks, operated by a key, or simply left unlocked.

The Examination of Disc and Pin Tumbler Locks for Toolmarks Made by Lock Picks by Wayne Plumtree. Published in the Journal of Forensic Science, October 1975

Forensic Locksmithing has been an active discipline in the US since the late 70s, but unfortunately still finds itself mostly relegated to insurance disputes in civil courts. I don't believe that it would be worth anyone's while to tediously investigate every lock involved in a non-destructive entry, and as a good friend pointed out to me recently, "It doesn't matter if locks are being picked, because the common targets of burglary don't require that level of sophistication." Basically - if someone is bothering to pick the locks, they are working too hard.

So, on an incident by incident basis, it isn't worth investigating, and knowing whether or not locks are being picked regularly also won't have an immediate impact on the security lifestyle of the average consumer. Forensically investigating a single lock won't likely help anyone. Even looking at that 12.7% clearance rate on burglaries you might think it leaves plenty of room for improvement, but I don't actually think forensics is going to make much of a dent there. However, even with all of that said, I still think the data is important.

What refined data provides is information for criminologists, social scientists, criminal justice and law enforcement professionals, and, of course, security hardware manufacturers. If we could investigate even 1% of the locks involved in non-destructive entries, we would have a massive study of several thousand locks to definitively answer whether thieves pick locks. And no matter what the answer is, no matter if it is 1% or 20% of entries, that data could be the seed that improves the future security of everyone in the country.

I'm not optimistic that we'll see that 1% anytime soon. So, I've been trying to figure out a way to get some data about rates of surreptitious entry that wouldn't rely on forensic investigation. I realized that there was only one person that would always know if tools were used in a non-destructive entry. The perpetrator.

The Bureau of Justice Statistics releases all sorts of amazing data, but for our purposes it issues a report every year describing the make up of the current US prison population. As of 2011, there were approximately 1.5 million people incarcerated, and of those, 10% were charged with burglary. There are also large numbers of convicted burglars who are either on parole, or have completely served their time. I would love to put together a survey for that population.

I have no interest in guilt or innocence, in gathering any information that could be used against anyone, or even that would positively identify them. I would just like to ask, anonymously, two questions:

1. Do you have first hand knowledge of surreptitious entry tools and techniques?
2. Do you have second hand knowledge of entry tools and techniques?

These would have to be worded carefully, administered carefully, and just generally thought through very, very carefully. It is a very early idea, but identifying the technical capacity of the population of convicted burglars could help to confirm or dispel a lot of assumptions on which we have based our security development, investment, and posture. While I don't have high hopes for that ever happening either, just thinking through the mechanics of how to acquire information that could inject some data into this sea of "common sense" has been very useful to my own work.

So, what about my friend's second point, then? That it doesn't actually matter if the average American improves the quality of the lock on their door? While I still want to see better options made easily available to consumers, I actually agree with that. I've been think a lot about a "post-lock"society.

Post Lock America:

Our modern relationship to locks is very different than it was even a hundred years ago. The watershed events of the Great Lock Controversy of 1851 suggested the possibility of a "Post-Lock Society". Specifically, there was a fantastic editorial at the time that stated quite plainly that now that we knew how to open each other's locks, perhaps we would evolve as a society beyond the need for locks. That our collective vulnerability would lead to mutual concern and empathy.

Though I first laughed when I read that, more and more I think it may have been almost true. The intersection of Security and Society has been a very active interest for me over the past few years. The more I talked to people, the more I gathered anecdotal evidence that the lock was serving more as a social construct than a mechanical construct. The lock on your door is imbued with cultural taboos, law, and the threat of violence. It is those three things that are actually keeping you safe, the lock is just a totem.

After years of talking about this I had a long talk with David Rees, host of "Going Deep with David Rees". At one point in the conversation we had an exchange that went something like this:

> *David: ...and there are plenty of people who don't lock their doors—*
>
> *Me: Yes, but that's a different thing. An unlocked door is just an unused lock, not some validation of the security of your community. If you really wanted to demonstrate the relative safety of your community, you would have to remove your lock altogether. And no one is willing—*
>
> *David: I'll do it!*

We discussed that, and the logistics of it, for a long time. How would the experiment work, would anyone even notice, if they were somehow made to notice, would it matter? While David didn't end up going lockless (he had just started renting part of his house to another person who wasn't part of this conversation) he was the first person I mentioned this to who said "I'd do it!" And I really believe he would have.

That got me thinking, are there other people out there in America, right now, who would be willing to go completely lockless? A few months after I started wrestling with the question, a coupon for Google Consumer Surveys found it's way to my email. I acted a bit too quickly, and screwed up part of the methodology, inserting some accidental bias in the survey, but there did seem to be some small core of folks who were willing to go completely lockless.

I enlisted the help of many friends who set up a series of surveys for me to systematically approach the problem. To my genuine surprise, the survey data suggests that up to 8% of the "internet using" population in the US would be willing to go lockless. That isn't a huge number, but at the same time, considering how extreme the question is, it's kind of a huge number.

And it got me thinking about that conversation with David. One of the questions that came up was how his neighbors would react. I told him I thought they would be apprehensive, but now I had a way to test that. With my friends we set up a series of surveys asking a single, escalating, question.

1. If a neighbor told you they had decided to live without any locks on their home, would you feel...[Less Safe || Neutral || More Safe] ?
2. If several neighbors told you they had decided to live without any locks on their homes, would you feel...[Less Safe || Neutral || More Safe] ?
3. If your entire community chose to live without locks, would you feel...[Less Safe || Neutral || More Safe] ?

I was wondering, as I started the survey, if mechanical security could have a sort of vaccine effect in a community. If everyone was adhering to the basic security practices, people could feel comfortable, but as individual members of that community defect from security precautions, would their neighbors feel that they were reducing the safety of not just themselves, but the community as a whole?

Well, according to our survey data, if even a single person defects (question 1) 25% of respondents would feel less safe as a result. Up that to "several" and 33% feel less safe. They feel this way despite their own security, on their own home, not changing whatsoever. I believe these results suggest a deep connection between feelings of personal safety to the collective security of your community. Frankly, I think I worded the final question poorly, so though the results were impressive (50% less safe) I believe there may have been an accidental implication that "everyone" included the respondent, thus I'm discarding that data point. Despite that mistake on my part, I am confident in the results from the first two questions, and I am equally confident that they reveal something fundamental that I've been trying to eek out for years.

Next, assuming that an individual could be made to feel less safe by the personal security posture of their community member, I wondered how people would feel about regulating a base level of security in their communities. My collaborators and I created another series of escalating questions, going from hyper-local to national in scale, to see what people would tolerate in terms of regulation.

1. If an organization in your neighborhood or apartment building mandated the use of locks on all residences would you be... [Supportive || Neutral || Opposed] ?
2. If your town or city proposed an ordinance requiring locks on all residences, would you be... [Supportive || Neutral || Opposed] ?
3. If your state proposed a law requiring locks on all residences, would you be... [Supportive || Neutral || Opposed] ?
4. If congress proposed a federal law requiring locks on all US residences, would you be... [Supportive || Neutral || Opposed] ?

Again, with the most extreme question, I am concerned that by using the word "Congress" instead of the more neutral "Government" I may have injected some additional bias, so the most extreme result may be suspect. Also, I was disappointed after getting responses back that the first question used the word "mandated" while the others used the word "required". Subtle differences in language are inappropriate for rigorous data, and thus, I don't feel comfortable using these for anything but a general guide. Still the responses remain interesting

In a neighborhood or apartment complex, 47% would support a basic lock requirement, and only 13% would oppose it. At the town/city level we see a drop in support to 41% and a rise in opposition to 19%. At the state level, support drops dramatically to 33% and opposition hits 20%. Nationally, support and opposition switch positions on the survey, with 32% opposed and 20% supportive. From this, I suggest further evidence that our ideas of safety and security are tied directly to our local communities, reducing in influence the further away we get from our own home.

Legal Implications of a Post-Lock society:

While putting this collection together I was gathering all of the notes I've taken over the years, both on paper, and digitally. I came across one, in an untitled Google Doc, that I think I must have jotted down just before falling asleep, because I have no memory of it whatsoever.

> *"Does existence or toggle status of lock have any bearing on police entry?"*

My immediate assumption was that a door without a lock, so long as it is attached to a home, would still be inviolable without a warrant. Then I started looking around...

> *"The modern test used to determine whether a person has Fourth Amendment rights in an object or place is whether the person had a reasonable and legitimate expectation of privacy in that object or place."*
>
> *—Aaron J. Sussman*

So, the question becomes, does the lack of a lock on the door diminish the expectation of privacy?

> *Significantly "the doors to the hallway were not locked and entrance into the hallway was not limited or guarded." Given that the hallway was readily accessible to the general public there was no expectation of privacy in the hallway and thus the initial intrusion was not unlawful.*
>
> *—David Louis Raybin*
>
> *"Who's there? The parameters of police 'knock and talk' tactics."*

Now, a hallway is not the front door of a home, but suggesting that entrance to a door not being "limited or guarded" implies that there is no expectation of privacy is worrying. And it appears that at least in some circumstances, police will err on the side of entry if they come upon an unlocked door. Many "how to handle the police coming to your door" guides state explicitly that if you choose to open your door at all, you should fully exit your home and lock your door behind you before engaging in any further conversation.

Even if that is overly cautious, how things would play out in the complete absence of a lock isn't yet known, but, there may be important precedent. In a case before the Supreme Court in 1968, the question of whether an officer could open an unlocked door without announcing his presence was up for debate. The central argument surrounded US Code Section 3109:

> *"The officer may break open any outer or inner door or window of a house, or any part of a house, or anything therein, to execute a search warrant, if, after notice of his authority and purpose, he is refused admittance or when necessary to liberate himself or a person aiding him in the execution of the warrant."*
>
> *—Sabbath v. United States | 391 U.S. 585 (1968)*

In the case in question, the officer had entered a home to execute a warrant. He did not announce himself, but, finding the door was unlocked, simply turned the knob and entered. The argument from the officer's attorneys was that opening an unlocked door didn't apply to § 3109, as he didn't "break open" anything. The court's opinion was quite the opposite.

> *"An unannounced intrusion into a dwelling -- what § 3109 basically proscribes -- is no less an unannounced intrusion whether officers break down a door, force open a chain lock on a partially open door, open a locked door by use of a passkey, or, as here, open a closed but unlocked door."*

And though at first I worried that "unlocked" and "unlockable" might still leave room for question, the Justices cleared that right up by drawing a parallel between police entry & burglary.

> *"While distinctions are obvious, a useful analogy is nonetheless afforded by the common and case law development of the law of burglary: a forcible entry has generally been eliminated as an element of that crime under statutes using the word "break," or similar words. Commentators on the law of arrest have viewed the development of that body of law as similar.... What constitutes 'breaking' seems to be the same as in burglary: lifting a latch, turning a door knob, unhooking a chain or hasp, removing a prop to, or pushing open, a closed door of entrance to the house -- even a closed screen door . . . is a breaking. . . ."*

Emphasis mine. Obviously I'm not a lawyer. I'm just asking friends and doing some light research, but the strength and specificity of these decisions certainly gives me hope. That said, going lockless will have other complications to consider. In the event that you are burgled, you may have a harder time with your insurer. It appears that in the US, burglaries enabled by unlocked doors and windows are covered by insurers without any problem. The same doesn't appear to hold true in England, where not only does it "go without saying that your insurer is unlikely to pay out if your house is broken into after you have left the door unlocked." (Katy Ward, Yahoo! Finance UK) but the Police have even threatened to report unlocked doors directly to insurers:

> *"This is one of a number of measures we are trying to get the public to take more responsibility. It is radical, it's going to be unpopular but it's something I will defend."*
> *—Chief Supt Nick Adderley via the Telegraph*

And considering how many of your neighbors would feel less safe if they found out someone was living lockless, I can only imagine how an insurer would take it.

How I've Tried to Imagined Trespass

Recently I got it into my head that locks were the oldest complex mechanical object in the world, especially after an informal twitter survey seemed to confirm my suspicions. Then I bumped into another anthropologist at a party who just said "animal traps" and broke my heart. As you know, I love locks. In a weird way.

I've recently come to terms with the idea that I'd probably be willing to lose a foot, if the alternative was never interacting with locks again. I like the smell of locks, and the weight of warm brass in the center of my palm soothes me. For years I would sleep with locks in the bed, until my wife put a moratorium on that, end yet I still keep one on the end table, often falling asleep with it held in my hand. My relationship to locks is extreme, but somewhere in your subconscious, you too have an emotional connection to *one of* the oldest mechanical objects in the world.

I started out as a competitive lockpicker. I didn't really know what I was doing, but I had a knack for it and I was embraced by the best pickers in the world who taught me well. I quickly found myself observing my surroundings from a layer of abstraction that no one else seemed to be on. I'd notice every lock I passed, the world was a little different than it used to be.

I still know where to find a Kaba Peaks in Mission Hill, an ASSA Twin in Somerville or a Schlage Primus in Cambridge. Boston was lousy with Yale locks in particular, from the exotic Bicentric master key system still found on some doors at MIT, to hundreds of gorgeous brass padlocks scattered throughout the tunnels and terminals of the T. As I would stare at them I became a bit anxious. That feeling was my first introduction to the innate emotional connection we have to security.

I would look at a lock and think about how I might open it. Something about that knowledge, coupled with very publicly investigating the cylinder, would inspire a bit of fear. Something crept in and told my body to stop doing that, to leave it alone. If I pushed myself further and actually reached out to touch the lock, it was both thrilling and terrifying. On a subway platform, with dozens of people standing around, I would gently heft a padlock on a gate, turn it to inspect the keyway, admire it, and all the while fight the instinct to let go, hide my movements from passerby and walk away. Even my friends, seeing me stare at, or touch, a lock in use, would feel uncomfortable.

When you stand at the threshold between public and private space, knowing you can slip through it, you change a little. Your shoulders tighten and your breathing shallows. You are a little more aware of your peripheral vision. You may have experienced this feeling too, though to a lesser degree.

Just imagine an open door with no lock on it. How comfortable are you moving into that new space. How foreign does it feel to your current environment. If it is propped open with no lock, does that imply that it is simply an extension of where you are now?

So add a lock. The door is still open, but now there is a lock on it. As you approach, that lock tells you that there are times when this is off limits. This space isn't always for you. As you cross the threshold do you look around for someone, do you want more explicit permission to enter?

Let's close the door, but we won't lock it. You are now standing in front of an unlocked, but also unopened door. How did you find out it wasn't locked? Did you try the handle? What did it feel like when you grabbed the knob, turned, and it gave way? Do you open the door boldly, or do you press against it slowly? Are you afraid to make noise, or are you trying to announce your presence? How easily do you step through?

Are you holding your breath?

Now what if the door were closed and locked, but you were going to find a way in? Whether through manipulation or force, you would get through to the other side. Are you excited? Are you scared?

And what will you do on the other side of that door?

Lock Fiction

Years ago I started writing a story about a lockpicker for hire for National Novel Writing Month. Every now and then I come across it again and I think "This is embarrassing...but not awful?" The idea behind the story was to think through the practical application of myriad attacks I knew, and then cast a protagonist who could both carry out and explain those attacks to those around him.

This selection is all about the problem with regional keying of high security locks. Basically, if you can get a legitimate key for a facility, then encoded within that key is an important part of the security of every other key. With very secure locks, they try to avoid having that information be the most secure part, but in the case of the Schlage Primus...well, I'll let the story tell you.

The Regional Sidebar Exploit

"We need a key" Charlie announced to the small team assembled before him.

"You are supposed to be our key, Charles." Carl said.

Charlie smiled, it was good to be working with Carl again, and this was one of the rare jobs where Charlie was well informed and working with other people. "And I can be your key, but it's not the best solution. Listen. This is a large compound, Schlage Primuses on every exterior door, most of the interior doors, and specifically the two doors you guys need open. There is certainly a proprietary sidebar code across the whole thing. If we can get any individual key, it doesn't matter if it's to a damn broom closet, so long as it's got a Primus on it, we'll be in business."

On the rare times Charlie had a team to work with Carl always provided paper and pens so he could better describe his plan. Charlie started drawing now and talked everyone through the concept of a sidebar. "This piece of metal blocks the shear line just like the pins do, so now we have to attack both locking mechanisms, our job just got a lot harder. Not to mention that the Primus finger pins are like Medeco pins, they both lift and rotate. Now, there are some concepts in try-out sidebar keys we could mess around with, but none of them work well that I've seen. What we're going to exploit is called regional sidebar coding. Basically, rather than build a high security mechanism that has a variable 2nd locking mechanism that would allow them to masterkey it, Schlage has chosen to employ a static one, and use the traditional pins for masterkeying. That means that the sidebar code in every lock in this facility will be exactly the same. There is a national level sidebar, which is the lowest security, because it's easy to get your hands on a key with the right sidebar to set any of the locks. Then they get more granular. You'll have a locksmith with his own sidebar code that no other locksmith can have, or a company that purchases it's own sidebar for all of their facilities. I have a friend who actually purchased his own sidebar just to better research the locks. It's expensive, and it's static. The point is, you get a key from anywhere in any one of these buildings, and we'll have reduced the security level in the entire building to be about as secure are your grandmother's front door."

Mark, a guy with no discernible skills and maybe 2 years younger than Charlie, interjected, "I don't get it. So we've got a key with the same sidebar, so what? It still isn't going to work in our lock, is it?

Or are we supposed to find a master key, 'cause that's harder."

"No, no. Once we get a key, any key, we can set the sidebar. I mean, I can literally make it into a tension wrench, just cut it in half through the bow. The fatal flaw here is that Schlage's secondary locking mechanism is worthless in this context. Like I said, a normal Schlage lock is probably just fine for your Grandma's house, but in a high security application, it's awful. Not only that, but because this is a big office complex it's bound to be masterkeyed. So the already simple, secondary locking mechanism is further degraded. Carl could open these locks with that sidebar set. So, we get the key, cut it down and use it as a tension wrench to pick the doors you need to open. I promise, with that sidebar I can pop the locks in a heartbeat."

"You won't be doing the popping." Charles said, quietly.

"Oh." Charles looked up, Mark was smiling sheepishly. "I see."

"Nothing personal, but you aren't an easily renewed resource for us, can't afford to risk you being associated with this if something goes wrong." Carl said.

"No worries, just get me a key, bring it back here and I'll get you set up with a sidebar tension wrench. It'll be simple as dirt from there." Charlie said and nodded at Mark.

"Sounds good, sir." He replied. Charlie smiled at that. Couldn't feel bad about a kid who called him sir.

Charlie and Carl waited in the conversion van while the rest of the team, 4 in all, started canvasing the various buildings on the company campus. Carl read, Charlie napped. A few hours later he woke to the side door sliding open.

"I'm probably compromised, but we got you the key." Said Kenneth, who Charlie considered the smartest of the bunch. "Also, I had to break the bow off, hope you can deal with that, because we should move ASAP." He handed the broken blade of the key to Charlie.

"How'd you get it?" Charlie asked, impressed by the drama of the situation.

"Well, Carl had us some low-level credentials, visitor passes, that sort of thing. I went in acting like maintenance. Tried to get a secretary to give me her keys to get access to the elevator machine room. She said she didn't know if her key would work, and insisted on coming with me. She tried her key in the door, of course it didn't work, but I asked if I could try it anyway, just in case, and snapped the blade off in the lock." Kenneth explained, smirking at the last part.

"You guys had extractors?" Charlie was chuckling.

"I did, Kenneth and me were workin' the same building so when the secretary left he shot me a text message-" Mark said, but Kenneth interrupted.

"She wouldn't let me alone after that! She left the lock, but made me come back with her and explain myself to her boss!" Kenneth was laughing now.

"Anyway," Mark picked up the story again, "He shot me a text, gave me the gist and I went down, extracted the blade, and hit him back saying it was done." Mark indicated his cell phone.

“And I pretended that text was an emergency across campus and promised I’d be back.” Kenneth finished.

“That’s great, guys. They’re gonna notice pretty quick when the keyway isn’t jammed up though, huh?”

“Nah, don’t worry about that,” Now Mark was smiling, “I jammed my house key in there about three-quarters of the way in, it was just a normal Schlage SC4, but still, it fit right in there, and I broke it off. Gonna be a real bastard to extract though, cause after I snapped it, I shoved it in as far as I could with the stub of the key. Gonna be misery to get out.”

“Genius! Nice one, Mark.” Charlie exclaimed. His opinion on Mark’s value was changing rapidly.

“Yeah, but I’m still worried. They got SFICs in there, Charles-”

“Please, call me Charlie. Carl is the only person who calls me Charles and if I could afford not to tolerate it I wouldn’t.”

“Heh, no problem, Charlie. Anyway, it’s Small Format Interchangeable Cores everywhere in the building. Even with the sidebar it’s going to be wicked hard to pick.” Mark said.

“Nope. Not with Schlage. Those are actually LFICs, Large Format I-Cores. When BEST came out with the SFIC format the primary goal was to corner the apartment and institutional markets, and they did, like crazy. SFICs were so easy to swap you could do a whole building in a couple of hours, no one else could compete. And the way BEST did it was very clever, and very secure. It not only made it much easier to rekey a door, but made one of the first commercially accepted leaps forward in improving the security of masterkeyed systems. Schlage, on the other hand, saw themselves losing market share and had to come up with something, fast. Thus was borne the LFIC. Instead of having a completely separate sheer line to operate the locking dog that holds the core in it’s housing, like BEST, Schlage just added the equivalent of a check pin to the very back of the lock. The change key is just the master cut onto what they call a 6.5 pin blank. So when you master an LFIC it takes the same hit to security that any normal pin tumbler takes.” Charlie said, “It’s going to be a walk in the park, trust me.”

“Awesome. So, can you make the tension wrench with that?” Kenneth asked.

“Yeah, absolutely, just need some super glue, do we have any in the van?” Charlie had been turned around in his seat, facing the guys in the back, but now he faced Carl in the driver’s seat.

“Don’t think so; Eddie, John, check it out, you don’t see it back there one of you run to a CVS or something, right now. Go!” Carl ordered.

Neither Eddie nor John found anything in the van, and both went in opposite directions to find some glue as fast as possible. While they were out, Charlie maneuvered himself into the far back of the van, with Mark watching his work over the seat back. Kenneth went to the front and was talking in low tones with Carl. Charlie was glad he had insisted on the vice, he had the key blade locked in tight, making sure that the sidebar was completely covered, with only the bitting sticking up. He didn’t have a dremel this time, but they had a small hacksaw and he cut the exposed section of key right off. Mark handed him a file and Charlie removed the sidebar from the vice and cleaned the cut surface as much as possible. He then did the same to the section where the bow had snapped off of the blade.

“Mark,” Charlie said, “This is the only thing that really matters in there. Schlage’s are shoulder stopped, not tip stopped-”

“So the key indexes itself against the front of the lock to line up with the pins, I know.” Mark added.

“Right, exactly, the shoulder of the key stops against the face and that’s how you line your key blade up with the pins. However, we don’t have a shoulder anymore. The nice thing about the sidebar is they are usually pretty tight, with great spring pressure, so even without the shoulder, when you place this at approximately the right depth, the fingerpins should draw it right into position. I’m going cut a thin channel out of the broken end so I can secure a normal tension wrench in there. It’s going to be a little tricky, and if you lose it, if it starts to slip out of the channel, abort. Remove the broken key carefully and get back to the van. Understood?” Charlie asked.

“Understood, sir. Can’t wait.” Mark gave him a smile and a quick nod.

John got back 10 minutes before Eddie, though both found glue. By the time Eddie got into the van the sidebar tension wrench was ready.

“It’s makeshift, you understand. A whole key would have been the most stable option, but I’m confident this is going to work for you. Let Mark call the shots when it comes to the doors. It’s going to be an easy pick, but it’s the wrench I’m worried about. He’ll let you know if it won’t work. Carl, you going with them?” Charlie turned his attention from the 4 younger guys to Carl.

“No. As it turns out I’m not much of a renewable resource, either. These guys know this is, most likely, one job and they’ll never hear from me again. You and me, we have to keep out of the limelight on this. Plenty of adventure still awaits us, Charlie my boy.” Carl said.

“You called me Charlie!”

“Well, ‘Charles my boy’ just didn’t have the same ring to it.” Carl grinned.

Charlie laughed, “You are excited. You’re in a good mood.”

Carl reigned in his facial expression, “Don’t ruin it.”

Charlie didn’t.

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Mark was impressed. The first door had gone exactly as Charlie said. The sidebar drew in, the tension wrench held, and the lock fell open in under a minute. Kenneth, the only one of them to work with Charlie before, brought back in because he had come out of the last job clean, seemed to be getting impatient after 30 seconds. Didn’t matter though, Mark was impressed with this Charlie guy.

The 4 of them entered the room and Mark simply took a seat and waited for the others to do their work. Kenneth went through everything in the room, all of the guy’s drawers, a wardrobe in the corner, a globe that converted to a bar, his trash, everything. They had been talking on the way from the hotel to the job, telling stories, though it was mostly Mark doing the talking. The one story Kenneth told was how he saved what looked to be a complete botch job he was assigned to back when he was still working with the police.

Mark was impressed with Kenneth, too. He didn't know Eddie well, but he seemed like he must be the computer guy, or, at least, when they got in he made a bee line for the computer and got to work. John's job was to plant two bugs and make sure both were operational. His was the fastest job after Mark's and he, too, sat silently waiting for the others when he was done.

Eddie retrieved something from the back of the computer that Mark hadn't notice him insert in the first place. He stood and looked at Kenneth, who took out a small notebook, held it in his left hand with his index finger extended to say "One minute" and wrote furious for two pages. He looked up, nodded at Eddie, pocketed the notebook and went for the door.

Once outside, John walked down one end of the hallway, Eddie the other, while Kenneth stood with his back to Mark, all of them watching, ready to give an alarm if someone happened to come around a corner. Mark knelt by the door they had just left and fumbled as he tried to pick the lock closed. He dropped his deforest pick and grabbed an L rake he had been holding in his mouth. He released and reapplied tension, inserted the rake, and the lock slipped open. The plug turned 90 degrees then stopped. The bolt that had fallen open so easily was now resisting the motion to close. Mark put a little extra weight on the tensioner, trying to be careful not to separate it from the broken key. It wasn't enough, he could feel the glue giving way as he applied more pressure and quickly stopped. Digging through his kit, Mark found a sturdier wrench, slipped it into the lock above the other. He couldn't remove the key, as the sidebar was pressed firmly into the blade and wouldn't release until the lock was back in it's closed position. With the stronger wrench he was able to close the bolt. Mark turned the plug closed, removed both tension wrenches, picked up the deforest and stood up, looking around to be sure they were clear. Kenneth nodded to him and they moved down the hall together to the second door.

Rather than bother with a standard pick, Mark went straight for the L rake again and marveled at how quickly it opened these locks. Charlie had been right about the high level of master keying. Expecting that this bolt would throw as easily as the first Charlie didn't pay much attention to the amount of force he spun the plug with, until the tension wrench separated from the key blade. Kenneth heard it clatter, saw what had happened and stared, eyes wide, at Mark, who looked back up at him in horror. He dug through his kit, trying to find his extractors. After ten seconds of searching Kenneth interrupted.

"Just get it open, find whatever you need while you wait for us, but hurry it up!" He whispered.

That snapped Mark back to his senses, he placed the thicker wrench back into the keyway and threw the bolt. Kenneth turned the knob and passed silently inside. John and Eddie fell in quickly as Mark hastily packed his tools away and followed them in.

Everything went as before, except that Mark was having a very private panic attack. He had left the extractors in the van. When he had pulled the key from the original lock he ran off in a hurry, jamming the key, along with the broken key extractors into a coat pocket. He wasn't wearing that coat anymore. There was one positive. He realized that locking the door would be a piece of cake, and slipped a hand into his trouser pockets and briefly there was a quiet ratcheting sound coming from them.

"A needle, or a safety pin, do any of you have one? Or have you seen one, Kenneth?" Mark asked the room, quietly, but it seemed very loud and very sudden compared to the relative silence of his compatriots.

John shook his head and Eddie didn't even look up from the computer. Kenneth started to shake his, but then thought of something. He went to the desk and pressed on the stapler, then turned it, depositing a folded staple onto the blotter. He held it up with his eyes raised in question.

"Yes!" Mark breathed. He retrieved the staple from Kenneth and sat back down, prying one of the two folded arms back up. In his kit was a bending tool, meant for shaping blank strips of spring steel into unique tension wrenches. Using that, Mark started to bend the very tip of the arm backward, toward the top of the staple. He did this until the tip was facing the opposite direction of the arm, then dragged it across his palm. The staple caught and, small as it was, pulled on his skin with decent force before releasing. Mark placed the staple between his right canines, holding it in his teeth so he wouldn't misplace it. When the others were done with their work, he joined them outside the office.

Mark has the wherewithal not to reset the plug when he initially picked the lock. He pulled the plug spinner he had been rigging out of his pocket. When they closed the door behind them, he stepped up and placed it's blade into the keyway of the still-picked lock and fired. The large spring around the barrel of the spinner snapped back into place, turning the plug so quickly around that the pins in the bible didn't have the chance to drop down into the keyway. With the blade locked into place he twisted it, turning the plug a little further, and pushed the bolt closed. Mark dropped the plug spinner, took the staple out from between his teeth, and very gently tried to pry the broken bit of key out of the lock. All of the features that helped him before, the smooth filing of the top of the key, the strong force of the sidebar pins, now conspired against him. He could barely get purchase, and even then couldn't overcome the holding force of the sidebar pins. Mark was ready to call it and run, but had one more idea. The staple was so narrow that, turned flat, it could fit into the notch Charlie had cut for the tension wrench. Mark extended the spur on the end of the staple a tiny bit, then turned the staple flat, slipped it into the notch, and rotated it 90 degrees. The spur caught, pressing into the bottom of the notch, with the flat of the staple jammed tight into the top. He pulled, slowly, the key slipped out 1 step, then the staple failed again. One step was enough, though. Mark grabbed his multi-tool, gripped the exposed bit of the key with the pliers, and slipped it the rest of the way out of the lock.

They were clear.

The Dabblers

"Few self-respecting professional 'inventors' have felt their mission to be fulfilled until they have 'invented' a lock of some kind." Henry R. Towne

In the 19th century the problem of security was at the forefront of mechanical curiosity. The Royal Society in England held many forums on the topic of mechanical locks and early American patents are riddled with curious lock improvements. It seemed like everyone and anyone felt compelled to try their hand at lock manufacturing. Presented here are a few of the would-be lock makers who went on to great success in other endeavors.

JACOB PERKINS

Jacob Perkins holds one of the earliest American lock patents for a "Vault Lock for Banks." In the US patent system it is predated only by Abraham Stansbury's Egyptian lock. Sadly, the records of this patent were destroyed in the fire of 1836. A quick peek at some of his other patents, though, reveals some of his future success:

#92X	Jan	16	1795 Machine for Cutting Nails
#236X	Feb	14	1799 Making Nails
#241X	Mar	19	1799 Check to detect counterfeits
#382X	Jul	09	1802 Pump
#1319X	Jun	16	1810 Copperplate Printing and mode of preventing counterfeits
#1340X	Jul	17	1810 Nail Machine, etc.
#1902X	Mar	23	1813 Vault locks for banks
#1903X	Mar	23	1813 Pumps
#1955X	Jun	26	1813 Water mill

As it turns out, the nail cutting operation would make him his fortune. In a curious precursor to the mechanical rivalries that would spring up in lock engineering, there was, for a great time in all nations, a desperate need for the rapid production of cheap nails. While a few inventors staked claims to being first, Perkins among them, he was certainly the most successful. At the time of his invention the average price for a pound of nails in the US was twenty-five cents. In the years following his invention, and the advent of several others, the price dropped considerably. By 1828 the price per pound was eight cents and finally hit bottom in 1842 at a price of three cents per pound.

With the money this brought in he was able to reinvigorate another passion, banknote printing. Despite his patent for copperplate printing, his major innovation in the industry was to switch to steel plates. This allowed for the production of many times the number of notes that their copper forebears could produce before wearing out. After some limited domestic success, he took his operation to Europe where he secured a contract to produce engraving plates for the Bank of Scotland.

Not one to rest on his laurels, he turned his attention to the production of accurate instruments for sailing vessels. He invented the Bathometer, a device for accurately recording depth by means of measuring the pressure of the water. More interesting, though, is his invention of the Orthometer and Pleometer. He trapped mercury in a horizontal tube, each end of which was turned upward at

90 degrees and enough mercury provided to partially rise into each end. The devices would be fixed to the ships cabin, one parallel to the keel, the other perpendicular. When the ship tilted or dove, the mercury levels would become unequal in the two ends. The difference in height could be measured and those measurements translated to accurate changes in the position of the ship.

Finally, and one invention perhaps not suggested by his early patents, he developed a steam powered machine gun. In the age of single shot weapons, his steam gun was able to pump out 500-1000 steel balls per minute with a penetrating power enough to pierce a 1/4 inch steel plate and even sported a movable joint for shooting around corners. The military never took him up on the design, so Perkins built the National Gallery of Practical Science, in which he prominently displayed his steam gun.

Despite success in all his myriad mechanical experiments, the one that remained unfulfilled was the lock.

E. B. DENISON

Edmund Beckett Denison was, by all accounts, a jerk. However, he also possessed a very clever mechanical mind. He was described as being convinced that he knew more than anybody about everything, and frustratingly, was often correct in that assumption. He found himself catapulted to prominence when he was assigned to oversee the bids for the contract to design Big Ben. Dissatisfied by any of the proposals, he created his own, which was accepted by the other judge assigned and eventually built. Not only did he design the mechanism, but also contributed to the creation of the bell. Which cracked. Twice.

He was active during the middle of the 19th century, and became swept up, as so many did, in the great lock controversy of 1851. He wrote articles, eventually a book, simply titled Clocks and Locks, and repeatedly lectured at the Royal Institute. After a long study of the locks of the day, he finally set about creating his own. He convinced some local manufacturers to produce a small number that he could give to friends and show at his lectures and even had some interest from a lock manufacturing firm in producing them, but in the end his lock never caught on. Perhaps it was his fervent refusal to participate in the British Patent system, which at that time was the benchmark for a quality lock and an assurance for lock manufacturers that they could legally protect their investment.

His lock was well thought out, though not exactly unique. It was repeatedly claimed that A.C. Hobbs said that Denison's proposed lock was the only in all of England that could not be picked, however, he was also on the record as stating plainly that there was nothing at all new in the invention, just a very smart rearrangement of other people's ideas. The principle innovation that Denison touted was a very light key that could operate a very heavy mechanism. The heavier the mechanism, the more secure against forcible entry. He accomplished this by removing the spring bias of the tumblers and separating the action of the key from the pulling of the bolt. The key merely raised the tumblers to the proper height, with only gravity to return them to their resting position. With the key inserted a handle would then be turned. The handle would retract the bolt, leaving the key to simply sit in place. He also integrated a curtain mechanism that theoretically blocked any tool from entering the keyway and manipulating the tumblers.

He certainly sang his own praises and even managed to get some others to sing them quite loudly, with Johnson's Universal Cyclopedia professing, as late as 1886, that it was "Perhaps the best English Lock." However, his detractors were vociferous. From The Mechanics Magazine, Jan-Jun 1858:

> *They are not likely to be made for sale. They have been puffed, as in the present instance, for six years, but no patent exists and no maker has yet been foolish enough to spend money on them. It cannot be said that they have yet been picked, because there has been none made for sale...To conclude; after all the vaunting which we have heard of Mr. Denison's skill, and all the hauter with which he has treated sound practical men whenever they have ventured to question his proud pretensions, we have at last to confess that his reputation as a man of practical science rests upon a cracked bell and a gimcrack lock, and that we really cannot recommend to the public the services of E. B. Denison, Locksmith and Bell-hanger.*

He was a remarkable character, and while he certainly upset a number of eminent figures in nearly every professional trade he tried his hand at, he also contributed a number of innovative ideas and did it all at his own expense with a mentality that many in today's open source movement would have recognized immediately. A final note, and most of the reason I wanted him on this list, was that he eventually became "Lord Grimthorpe" which sounds precisely like the sort of super villain that would make liberal use of Perkin's steam powered machine guns.

JOHN DILLINGHAM

Poor John Dillingham never seemed to enjoy the sort of success that the other dabblers did, but he is included on this list both for his absolutely fascinating and near comically complex lock as for the curious nature of his other, more successful endeavor; the cultivation of silkworms in Maine.

There was a time when the United States wanted desperately to reduce their dependence on foreign silk. To this end, many states began offering bounties on domesticated silkworms to encourage a domestic silk industry. As money was up for grabs many people got in on the action, there was only one big hurdle to overcome; Silkworms can only eat the leaves of Mulberry trees. In Maine, Dillingham's home state, there was a common belief that the Mulberry could not withstand the harsh winters, so despite the bounties being offered by the state government, no one was leading the charge. Dillingham, firm in his belief that a Maine silk industry would get his communities wives and daughters out of the fields, pushed forward. With 3 friends he managed to cultivate a grove of 100 Mulberry Trees and start breeding silkworms. In 1841 he sent a letter to the State Legislature which petitioned them for an additional bounty on mulberry trees and included a sample skein of silk they had managed to produce.

> *And here is the proof, or in other words the die is cast, the State of Maine is destined to become a silk growing distreck, and may be one of the richest and happiest state in the union. What is to prevent us from becoming so? Apathy on the part of ourselves, and neglect on the part of those whose province it is to nurture and protect the public interest.*

Sadly, whether by apathy or neglect, and despite a number of other people trying their hand at it, domestic silk production never really took hold in Maine the way Dillingham had hoped.

His lock, though, is at least as fascinating as his prior enterprise. It consists of 6 unique keyholes, several integrated locking mechanisms and a double-sided, triple-bitted key.

> *One valuable, important, and novel feature of this new-formed key is, the use of both its ends to operate in the several divisions of this lock; and without a knowledge of the co-operation of these opposite ends, one might find himself baffled to operate, even with the use of this, its proper key.*

Bafflement was an appropriate goal. He does an admirable job of describing the function in detail, and while republishing the entirety of his patent would be lazy and page-consuming, here are some highlights:

> *When the flange [a] passes into the lock, a half turn puts it into a position to pass through another opening, formed like the first, into a second division of the lock, and at the same time the first flange [a] is passing the second opening, the second flange [c] is passing the first opening [d].*

He is describing inserting the key into the first keyhole for the purpose of locking this lock. Once inserted you turn the key 180 degrees. This aligns the head of the key to pass into an interior key hole and the "middle-bit" to pass into the original key hole. You press the key in past the interior keyhole then start turning. As each bit comes around they apply force to a "vibrating plate" that in turn connects, through a hinged intermediary mechanism, to the bolt. As the vibrating plate rotates, the hinged connector rocks back and forth, slowly pushing the bolt out. However, this is simply the first phase of the locks operation, you must move on to the 2nd keyway.

> *This...key passes through this...key-hole and there operates on what has been denominated a plunger. Said plunger works back and forward as the case requires. When it is thrown one way, it throws the pawls out of gear at one end of the said main bolt, and throws the pawls into gear at the opposite end of this same bolt.*

Basically, the device inside the second keyway changes the direction the vibrating plate mechanism will pull the bolt. Skipping this step will prevent you from being able to unlock this beast, even with the key, in the future. One set of intermediaries are disengaged and the "unlocking" set are engaged. On to the third key hole!

> *The key, as described above, will be used in this case by changing ends; it enters this third opening, and turns a pair of bolts. This movement slides a plate over every opening, and effectually closes every other opening or key-hole in said lock...And again, this same key continues, and enters a second department and there operates on another pair of bolts and by this means the last mentioned pair of bolts are made fast and immovable.*

So, at the 3rd keyhole you once again pass into the opening, turn 180 degrees to align the "middle bit" to the outer opening and pass deeper into the lock. Turning the key again, each bit will press a bolt into place, fully locking this complex lock. The motion also pulls a plate over every other key hole so that no key or tool can fit into them until they are reset via this key hole. There is also a sprung guard that comes down after you remove the key, so that to the outside observer, this keyway looks just the same as all the others that are now blocked.

But, what about the other 3 keyways? Well, the 4th is actually relievingly useful:

This small key, or day-key, or clerks key, also enters the lock through the opening [u] and can operate and throw back and forward a pair of bolts. And, as this division is intended for day use, and if the clerks are provided with the small keys, they may operate on this fourth division, but cannot on any other part of the lock; but the proprietor, with his principal key, can render this small key entirely nugatory.

Basically - there is a separate key hole & simple bolt that clerks at your business could use for when they need to deposit money, make change, etc. So, the elaborate key swapping, multi-hole locking and unlocking procedure is only intended to secure the lock overnight. This is actually a smart feature of an otherwise overly complex and not particularly secure lock. Oh, and the other 2 keyholes? They are just there to be confusing. They appear to have no mechanical function whatsoever.

Considering the complexity of this lock, which, at the end of the day relies entirely on an attacker being unable to understand what's happening, rather than on any of the then-proven tumbler-based mechanisms, it is no shock that Mr. Dillingham didn't find any commercial success in the lock trade.

This list could go on nearly indefinitely. There are hundreds if not thousands of never-realized lock patents. So why did every mechanical mind in the 19th century take their shot at inventing a lock? I believe it is because for so many other endeavors in that period there were concrete problems that had very real and very permanent solutions, and discovering that solution could make you both rich and famous. Whether it was cutting & heading nails in one operation, making an incredibly accurate clock, or learning to plant your mulberry trees on high, arid ground, once you solved the problem, you could rest easy, knowing that you had solved something fundamental. With locks, however, you are not battling just with nature or machines, you are trying to best every other clever human mind. Locks have been evolving for thousands of years and there is no end in sight. The person who commits him or herself to the design and production of a lock cannot just stop when their patent comes in or their product hits the shelves. It is a lifelong, if not multi-generational commitment to the pursuit of a single, unattainable goal. Perfect security.

That quip of Henry Towne at the top of the chapter may have sounded encouraging out of context. Here is the complete quote, from his wonderful treatise 'Locks and Builder's Hardware.'

Few self-respecting professional "inventors" have felt their mission to be fulfilled until they have "invented" a lock of some kind. Apparently there is a fascination in the subject which they cannot resist, however complete their ignorance of the past achievements and present development of the art, and so each incontinently proceeds to "invent" things which, while new to his untutored mind, are usually already well-known, occasionally in successful use, but more frequently long since consigned to the limbo of useless and discarded schemes.

If the text of the "primer" has served its intended purpose it has shown that the essential elements of a lock are few in number and simple in kind. Practical success lies in adapting them skillfully to the intended purpose. In lock-making, as in other mechanic arts, this can usually best be done by those who possess the proper training, the best facilities and the broadest experience, and who have devoted their undivided attention and skill to the designing and making of good locks.

The Kroekel Boys

While doing some unrelated research into public understanding of physical security in the 19th century, I happened on an article from "The Silent Worker" about Charles Kroekel, a deaf child who was described as "the most precocious burglar ever behind the bars of a jail." This line, in particular, caught my attention:

> *When his deft fingers encounter a lock that they cannot pick he generally manages to squeeze through some small opening, and in this way he has escaped from nearly every place in which he has been confined.*

It went on to say that he had just been sentenced to 2 years in State Prison. According to the article he was 13 and had already spent three years of his life in jails & reformatories. I was intrigued and heartbroken in one fell swoop. I had to know more. Initially all I could find was a 2nd article. He was 18 in this one and had just been confined to the Camden City Jail pending trial. This article, too, commented on his picking prowess:

> *No cell was able to hold him, and, though he did not always succeed in escaping from the jail he was always able to pick the lock of the cell door. Among the police officials of New Jersey he acquired the reputation of being able to pick any lock ever made.*

Unfortunately there my research stagnated for nearly a year, but I couldn't stop thinking about him. I even found thin excuses to bring him up in various talks and workshops I gave. Lis Pardi happened to be in the audience during one of these digressions and over crepes after the event she offered to help me hunt down new information. One item she uncovered—among many—was particularly stunning. There was a brother!

> *Probably the youngest prisoner in the State charged with burglary was arraigned before Justice Breder this morning. He was the 10-year-old deaf-mute, Oscar Kroekel, brother of the famous mute, Charles Kroekel, who, notwithstanding his youth, has been in every penal institution in the State, and who is an expert at picking locks. Young Oscar bids fair to rival his brother. Within the past year he has on several occasions been arrested for breaking into dwelling houses…*

The fresh information Lis dug up provided me a number of new leads. Two other volunteer researchers, Andy Kelly & Molly Sauter also dug up new info on the boys.

We learned that Charlie started his lockpicking hobby young, around age 6. His talents were first revealed when his mother caught him opening a cabinet with a piece of wire. The mystery of a number of small thefts in the neighborhood was thus solved. Unfortunately Mr. & Mrs. Kroekel don't appear to have much patience for that sort of mischief. While he had been enrolled in a school for the deaf at a young age, his run ins with the law quickly overwhelmed his family and he was sent off to a reform school. To give you a sense of how these reform schools ran, their students were referred to as inmates. At the time his former school produced a short quote in their school newspaper:

Charlie Kroekel, who was a pupil here for two or three years, is now an inmate of the Reform School at Jamesburg. Charlie seems to be one of those persons who are born with an instinct for pilfering and other kinds of mischief. Yet he showed a pleasant, affectionate disposition, when here, and in all his mischief he never seemed to do anything from ill-will to any one, or to take any thing because he wanted it, but rather to gratify an uncontrollable impulse. It is a question how far such a person is responsible for his actions.

This is pretty consistent with every anecdote you'll find about Charlie. It was always curiosity and compulsion that appeared to drive his burglaries and escapes. When his mother caught him as a child he immediately led her to the trinkets he had pilfered, when he escaped from county lock up, he would simply walk down the hall to hang out with the guards. Never in any account does there appear to be malice or greed in any of his actions. And yet, he spent more than three quarters of his teenage years behind bars.

The reform school is one of the few places where he appeared to be painfully unhappy. He escaped several times running as far as Atlantic City before being caught or turning himself over to someone, cold and hungry. The school itself had a scary reputation and Charlie was far from the only kid to attempt escape. 4 boys who escaped together back in the late 1902 famously described their abuse to reporters before being put away again. As best I can tell things haven't gotten much better. A report from 2010 suggests that 1 in 3 children incarcerated at the New Jersey Training School (the current name for the same facility) were sexually abused by the staff.

In July of 1889 he was Found in New York City, breaking into a store. When he was picked up by the police, he gave them a note with his name and a small cry for help "I am hungry and sleepy". He was arrested, but the police appear to have treated him kindly. Of course, they discovered that he had escaped from the Reform School and got in touch. When an officer of the school came to claim him the next morning, he had vanished. They discovered that he picked the lock in the night. He made it all the way to Atlantic City (where he was again arrested for breaking into a store) before being arrested again and sent back.

CHARLES KROEKEL.

Eventually Charlie had escaped so frequently that eventually the administrators of the school refused to accept him. He was brought up on the new charges. The trial was pretty well attended, and Charlie apparently put on a bit of a show. This trial is the first time we get a description, along with an illustration, of him.

He is exceptionally bright and keen. He has light hair, blue eyes, wonderfully small hands and is as nimble as a cat.

As a joke, during the trial, he apparently passed a note along to the jury asking if anyone could spare a dime. Judge Reed, who had seen Charlie year after year, initially tried to hold off on sentencing. He was sympathetic, he genuinely believed Charlie was too young to go to prison, but the reform school refused him, and no other option was presenting itself. Reed sent Charlie back to the county jail for 5 months, where he seems to have been happy. For once, he didn't try to escape, but instead seemed to genuinely enjoy the company of the officers at the low security lock up.

It couldn't last though. It was always going to be a temporary solution, and after 5 months Judge Reed found himself out of options. In May, 1891, Charlie was sentenced to a year at a state prison. It was reported that he wept uncontrollably and couldn't be consoled. He was still only 15.

In jail he was lonely, but still curios. Though he couldn't hope to escape from the guards, he could still pick open his cell easily and would often be found in the walkways, with a small chalkboard, having conversations with other inmates. He would ask them about the world outside. His own parents had given up on him young, but now he had a hundred incarcerated fathers to learn from.

At 16 he was out again, but re-offended and was sentenced to another year of hard labor. At 17 he was released, quickly re-offended sent back to the same prison. At 18, he was out again, but seemed to be a changed man. When the press were as ever-present as the judges and police, he was known for playing pranks in the county lockup, and always joking even during his trials. But, on his way out the door at 18 all that made people root for him had been lost. The deaf community, turned on him as well. From an editorial in The Silent Worker,

> *We print this month one more paragraph about Charlie Kroekel, and here we propose to stop. This one deaf-mute lad, with a criminal twist in his brain, has had more said about him in the papers than all the honest, hard-working deaf-mutes in the country have had.*

They described a sign it's readers could invoke to demonstrate their displeasure with Charlie's recidivism. Eventually they did write about him again, when he was 20 years old they ran a sentence stating that he had been struck by a train and wasn't expected to live. Thankfully he did.

Between 10 and 20 years old, he racked up over 100 charges of burglary, was arraigned at over 30 different courts and was reportedly held in every correctional facility in New Jersey. He escaped dozens of times, and in all, spent nearly three quarters of those years incarcerated.

A few years ago, my curiosity with Charlie, and his brothers Oscar and Albert, who were both escape artists and lockpickers in their own right, led me to Egg Harbor City, where I visited their graves.

I was in NYC for a Grub With Us dinner and to see a few friends. I had a few hours free Thursday morning and decided I'd drive down to Egg Harbor City, NJ, home of the Kroekel boys.

I arrived at about 1 am, having left New York around 11 pm. I drove between the borders of the town to get a sense of its size. I slept in my car in a Rite Aid parking lot and waited for morning.

There were a few things I wanted to see. I had the address of their old house, the site of their burial and I knew that May's Landing, an adjacent town, was where Charles frequently ended up in court. Unfortunately, neither the house or courthouse appeared to be old enough to be original, but I did have luck at the Egg Harbor Cemetery. The moment I saw "Kroekel" I was mesmerized. I took photos of several of the graves.

Charles, the Eldest

Middle Brother, Oscar

Young Albert

Sister Minnie

I wish I had thought to bring flowers for Minnie's grave. It could have used a cleaning as well. Curiously, it seemed the oldest stones were the best preserved. While I hadn't thought to bring Minnie flowers, I did bring some tokens for Charles and Oscar. 2 cutaway locks I had made myself.

I searched around the car for a bit, but couldn't find the key for Oscar's lock. I was frustrated for a while until I realized that he probably wouldn't mind a missing key.

Timeline on the Kroekels:

With help from Lis, Andy, and Molly, I've been able to collect information from a number of sources. I still don't have a complete picture, but I have been able to put together a rough timeline.

1876	Charlie is Born
1883	Gets caught picking a lock for the first time
1883-85?	Pupil of the New Jersey School for Deaf-Mutes
1886	Oscar is Born
Jan. 1889	Charlie is an inmate of the Reform School at Jamesburg.
Sum. 1889	Caught stealing in NYC, escapes to Atlantic City where he is caught again.
May 1891	Sentenced to a year in the State Prison by Judge Alfred Reed
May 1891	Silent worker disavows Charlie.
Sep. 1892	Sentenced to 2 additional years at State Prison.
Nov. 1893	Is released from prison.
1893	Albert is Born.
Nov. 1894	Charlie is back in Camden City Jail for burglary.
Oct. 1896	Residing at Trenton prison.
Oct. 1896	Oscar is arrested for B&E at residence of George Voss.
May 1897	Charlie arrested in Egg Harbor for burglary.
Jan. 1898	Oscar is the "Youngest Prisoner in the State" On his way to the reform school.
Oct. 1899	Charlie is struck by "the cars" and "not expected to recover" He survives.
Oct. 1900	Albert is caught having run away from home.
Dec. 1906	Oscar, after watching a movie which included a burglary scene, returns home & imitates the act on a nearby building. When the cops arrive he said he wanted to see if he could do what he had seen in the movie and seemed quite amused by the whole situation. He was promptly arrested. He had been out on probation when this occurred.
1942	Charlie Dies.
1949	Albert Dies.
1960	Oscar Dies.

Rethinking the Origins of the Lock

The origin of the lock is a romantic story that finds itself planted firmly among some of the earliest civilizations. We can see some designs slowly migrate across the world, while others are clearly the result of independent technological evolution in disparate geographies. What is most remarkable, though, is how the lock, in some form, pervades every culture known to man.

For the past 210 years it has been generally believed that the first key-based locks originated in Egypt around 2000 BCE. However, recently there has been strong evidence emerging to place its invention elsewhere, and suggest a more precise, if somewhat broad window in which the first lock entered the world.

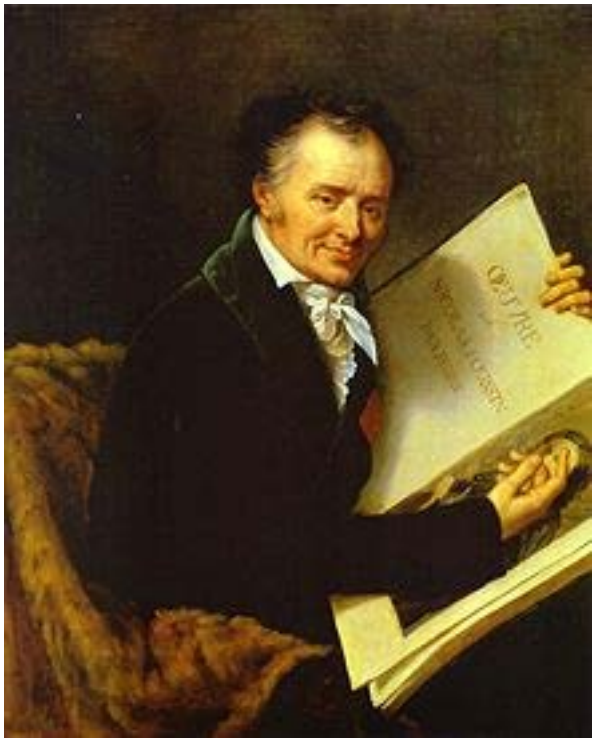
Relying on the efforts of some amazing archaeologists and linguists, I propose that the first key-based locks originated in Mesopotamia between 2500 & 1800 BCE.

(Re)Discovery

There were a few significant pieces of evidence to point to a middle-eastern origin of the lock, but what specifically led to the re-introduction of the pin-lock to modern, European society were the journals of Vivant Denon.

Vivant Denon was a talented artist, prolific looter and perhaps the most eloquent European to bear witness to the antiquities of Upper Egypt. He served in Napoleon's "corps des savants", a collection of 170 scholars from myriad fields who were attached to the military force that carried out the failed French conquest of Egypt at the tail end of the 18th century. While Denon's skill as an artist was used in the production of military illustrations, his primary mission was to explore and record the ancient ruins of the area.

> *...Denon was to be found busy sketching battlefields and soldiery for the glorification of the regime, but he was also tireless in seeking out and cataloging artifacts for transportation to Paris, his principal commission, with total indifference to the humiliation of the subject nations that were being robbed...he was in fact a looter on a scale that makes Hermann Goering look like something of an amateur. Under him, Napoleon's Paris, the new Rome, swiftly became the greatest art metropolis the world had ever seen.*
>
> *—The Age of Napoleon by Alistair Horne*



Toward the end of 1798, the French General Belliard was ordered to join General Desaix who was pursuing Murad Bey, an Egyptian resistance leader, deep into Upper Egypt. While Upper Egypt had been explored by a handful of Europeans throughout the 1700s, there remained many great

mysteries, so Denon seized the opportunity and successfully petitioned to separate from the rest of the scholarly brigade and travel with Belliard and Desaix, with whom he established great friendships, though their motivations were always at odds. Desaix was on a military campaign, Denon, a scholarly exploration, a friction made clear by an incident near El-Araba.

I knew that I was near Abidus, where Osymandyas had built a temple, and where Memnon had resided. I was constantly urging Desaix to send thither a reconnoitering party as far as El-Araba, where I daily heard there were several ruins; and as often Desaix said to me "I will conduct you thither myself. Murad-Bey is two days journey from us; he will come up to us the day after tomorrow, and we shall then give him battle, and when we shall have beat him, we can then bestow as much time as you will on antiquities, and I will help you myself to measure them." My good friend was certainly in the right, and even if it were not so, I must have contented myself.

> *At last on the 22nd, we quitted Girgeh at the approach of night, and we passed directly opposite to the antiquities. Desaix dared not look me in the face: "If I am killed tomorrow," said I to him, "my ghost will be always haunting you, repeating in your ears El-Araba."*
> *—Travels in Upper and Lower Egypt by Vivant Denon, translated by Arthur Aikin [1]*

The Colossi of Memnon on the plains near Thebes as illustrated by Denon

This was a purely opportunistic exploration, as Denon was well aware, noting in Travels in Upper and Lower Egypt, his published record of the trip, "I was therefor sometimes obliged to pass rapidly over the most interesting monuments; and at other times to stop where there was nothing to observe." Despite the transient nature of his adventure, Denon became the first modern European to document the ruins at Thebes, Esna, Edfu and Philae among others. The written account of his travels and myriad illustrations created incredible excitement and stoked the newly popular Egyptian art and fashion revival in Europe. Of particular note to lock historians, though, was Desaix's arrival at Karnak in July of 1799.

> *We arrived at sunrise at Karnak, where I did the honors of introducing newcomers to the site. At the same time, I checked the accuracy of my first operations. Among the new discoveries that I made through the rubble of the temple, I will quote a figure that I perceived on the outside walls of the small buildings that are next to the sanctuary. It was that of a character making an offering of two obelisks. I also noticed the representation of*

a temple gate, with two folding doors, shut by exactly the same kind of wooden bolts that are at present made use of. The excessive heat did not allow me to stop for a moment where the two bas-reliefs were located, and therefore draw them, but we can infer from these sculptures that obelisks, and such kind of monuments, were the votive offerings of princes and other great personages; and that even less monumental objects, such as doors, were also pious offerings...

—Travels in Upper and Lower Egypt by Vivant Denon, translated by Arthur Aikin

Unfortunately, Denon's translator, Mr. Aikin, chose to translate the French word "serrure" as "bolt" instead of it's correct translation, "lock", and for some reason neglected to translate the conclusion of Denon's thought, which turned out to be quite beautiful: [2]

...and finally that inventions of general utility are transmitted by a tradition that runs through all revolutions of nations. The image I give of an absolutely modern lock can stand in as a drawing of the ancient one, as I did not notice any difference.

The locks he was comparing the relief to could be found in use all over the middle east at that time. The design was ancient, as evidenced by both the relief and some artifacts recovered from other sites, yet had somehow persisted, nearly unchanged, for thousands of years. Working off of the original French publication and the plates Denon provided, engineers in England presented papers and commentary at the Royal Institution where it caused a great deal of excitement and speculation.

The simplicity and other advantages of this lock or bolt, are too obvious to require much remark; for which reason I shall confine my present observations to its degree of security or inviolability... We may admit that the ancient lock, with many pins falling independently of each other, cannot be picked or opened without its key... Now, if there be a number of these pins so placed and adjusted as to fall into their respective sockets at the position of the bolt when shut; if their lower tails be of different lengths, and a key be made to correspond with them, and lift them all to the proper height at once; the combination will be such as cannot be made out by any impression or tentative process upon the lock itself.

—W. Nicholson, A Journal of Natural Philosophy, Chemistry, and the Arts, 1804 [3]

Only months after the publication of Denon's journals we can see the seeds of what would become the most popular lock in the world, Yale's Pin Tumbler, grow out of the ancient design.

Metal keys and even some wooden locks dating as far back as the 6th and 7th centuries BCE had been discovered which supported the existence of the pin tumbler lock in antiquity. Unfortunately, Denon, in a description of an illustration included in his journal, included an offhand comment suggesting that the Egyptian lock had been in use for four thousand years.

I have placed it among the antiquities, because it is the same as that which was used there for four thousand years that I have found sculpted among the reliefs adorned on the great temple of Karnak.

—Vivant Denon, Voyages dans la Basse et la Haute Egypte, 1798-1799 [2]

Despite only having physical artifacts from the first millennium BCE, this was the phrase that would be forever repeated by excited European and American scholars for the next 200 years.

Thutmose III's offering of 2 obelisks via Digital Karnak

While Denon mentions in his journal that the oppressive heat on the day they arrived in Karnak was such that he could not stop to make an illustration of the relief, he does give us enough clues to guess that he was surveying the Palace of Ma'at. Dr. Elaine Sullivan, of the Digital Karnak project at UCLA [4], was kind enough to point me to this well preserved relief of Thutmose III making an offering of two large obelisks.

The Palace of Ma'at was built by Hatshepsut who reigned for more than 20 years in the middle of the 15th century BCE. Even if the relief did depict a pin lock, at the time of Denon's discovery it would have only suggested an age of 3200 years. We can forgive Denon his enthusiastic inexactitudes as he was speaking in fairly general terms, and trying to instill a sense of wonder at the nearly unchanged technology of modern middle eastern locks. It must have been thrilling to witness, all around him, such a direct connection to the ancient world. However, the incessant repetition by lock historians has obscured what could be the true origins of the first mechanical lock.

Door Seals

Also at Karnak, on the North wall of Hypostyle Hall, there is a small relief that depicts an older concept in locking doors. The mostly destroyed images show Seti I opening the shrine of Amun-Ra as part of a daily ritual offering. [5]

Seti I breaking the seal, withdrawing the bolt, and opening the shrine doors.

In the carving, now called Episode C, you can clearly see him removing a peg that runs through the door. Though Seti I built Hypostyle hall nearly 200 years after the death of Hatshepsut, this is a clear depiction of an even older method of securing doors than the pin lock, the clay seal.

Door seals have their own history, even more ancient than mechanical locks. A door seal was found on one of the deepest levels at Tepe Gawra, an archaeological dig site in Northern Iraq that dates back to the 5th millennium BCE. What are of particular interest to the lock historian, however, are the Mesopotamian door plaques recovered from the mid-third century BCE.

"Banquet Plaque" door seal via the Oriental Institute at the University of Chicago. [6]

These had a square or circular hole in the middle that a peg would be placed through, which would be connected by a cord to another peg through the door. The pegs would also pass through a long plank that acted as a bolt, holding the door closed. To open the door, one only needed to remove the peg, but once closed more clay would be added to the plaque, covering and securing the peg. This could be easily broken off, of course, but unless you could reproduce the intricate seal it would be obvious that someone had trespassed. This peg-through-plaque system seems like fertile ground for the innovation that would become the pin tumbler lock, and linguistic analysis may bear that out.

Clues in the Cuneiform

In the late 1980s there was an uptick in academic interest in Mesopotamian door seals and locking systems. With minimal artifactual evidence, scholars looked to clues in Sumerian and Akkadian writing to clarify their idea of ancient security devices. Following on papers published by 2 of his peers, Dr. Daniel Potts, professor of Middle Eastern Archaeology at the University of Sydney, entered the fray in 1990 with his article, "Lock and Key in Ancient Mesopotamia" [7] which found a home in an Italian academic journal bluntly titled "Mesopotamia." In the article he quickly identifies the root problem inherent in this kind of speculative research: interpretation.

> *Both E. Leichty and J.A. Scurlock wrestle valiantly with the Sumerian and Akkadian phraseology of locking, each trying to assign the various termini technici mentioned in cuneiform sources to one or another part of the locking system they believe to have been common in Mesopotamia. The results are completely different, as they must be, given the fact that each believes a different sort of locking mechanism was prevalent in the region.*
>
> *—Daniel Potts, Lock and Key in Ancient Mesopotamia*

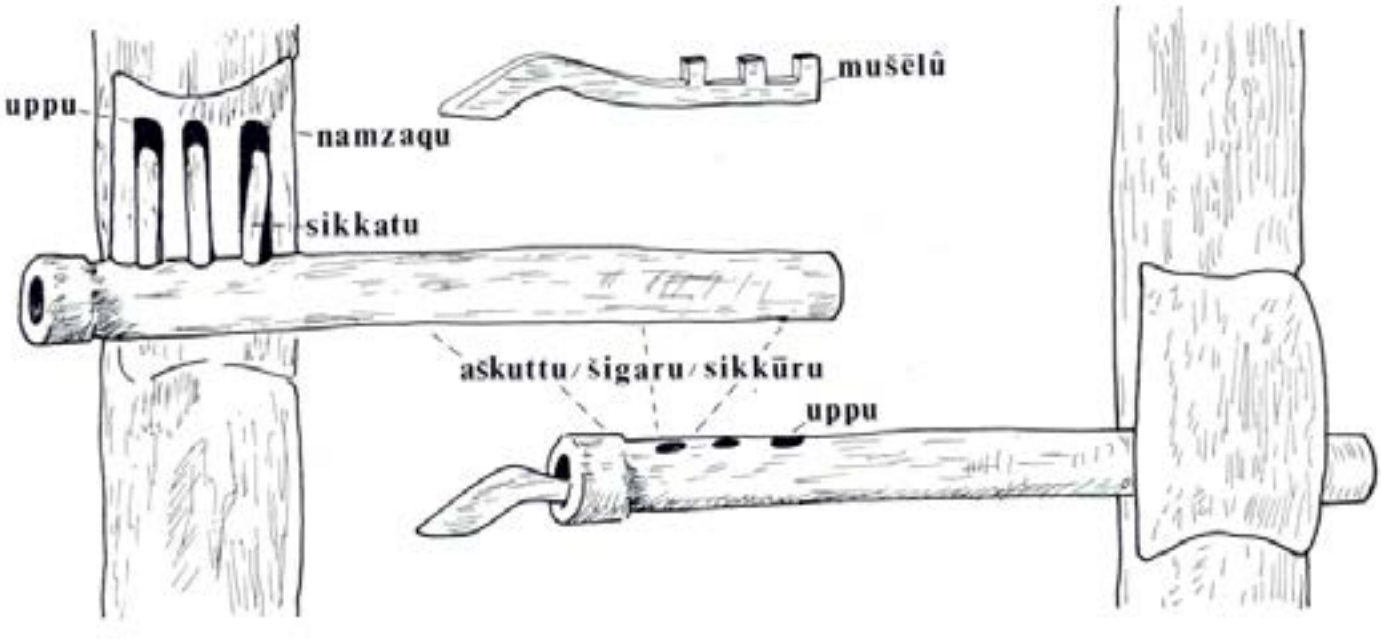
Both Leichty and Scurlock had attempted to bring the limited archaeological evidence available to bear in selecting the type of locking system they then bent the language to describe. Leichty used impressions left in the back of well-preserved clay seals to extrapolate the likely mechanisms they had been covering. Scurlock used the reconstruction of a lock found at a site called Tchoga Zanbil as his base. Each used their chosen example to define a collection of words that regularly occurred together in ancient writing. For his part, Potts believed that neither had hit upon the right concept for defining all of the parts of the locks in context. He proposed something else.

> *The difficulty of identifying these parts correctly lies, to begin with, in the choice of the correct lock system as a model, and thereafter in finding identifications which, in*

association with all of the other relevant terms, make mechanical sense. In contrast to Leichty and Scurlock, I propose to use the Egyptian lock as a model for the identification of the most important terms.

— Daniel Potts, Lock and Key in Ancient Mesopotamia

By "Egyptian lock" he was, of course, referring to the early pin lock. Using the pin lock as a model he was able to create coherent translations of several specific cuneiform passages. Of particular note was an ancient complaint found in a passage labeled "CT 40 12:7-15." Using the pin lock for context, we can see that the complaint charges that the pins (or sikkatu) in the lock (namzaqu) of the Istar temple weren't properly aligned with the pin chambers (uppu) in the bolt (aškuttu). This, as any modern locksmith would know, prevented the proper operation of the lock.



The Mesopotamian Door Lock as described by Dr. Daniel Potts

Potts' proposed definitions also provide an exciting clue to the possible evolution of the world's first mechanical lock. The sikkatu, translated as the pins in the pin lock, was precisely the same word used for the peg in the ancient Assyrian door seals. If Potts' theories could be confirmed this bit of information could provide the linguistic evidence of a direct mechanical evolution from door seals to keyed locks.

8 years later, Andreas Fuchs, participating in the Neo-Assyrian Text Corpus Project, published "Die Annalen des Jahres 711 v. Chr. nach Prismenfragmenten aus Ninive und Assur." [8] In one section, Fuchs set out to analyze the same constellation of lock terms Potts, Leichty and Scurlock had examined. The basis for his analysis was a list of the spoils of a campaign of King Sargon II. Sargon had removed the lock from the Haldi temple at Musasir as its various parts were beautifully made out of gold. The perceived value meant that the loot was well described in the accounting. This gave Fuchs the information he needed to not only identify the object as a pin lock, but even reconstruct it, drawing remarkably similar conclusions to Potts work.

Further confirmation of the existence of pin locks in Assyria was found in a 7th century BCE letter from a temple to their king, stating that an apprentice to "Adad" somehow managed to lose the key to

the temple. While it does not explicitly mention the type of key or lock, the pin lock was the security technology known at that time that actually used a key.

Unfortunately, this linguistic analysis, as advanced as it was becoming, was lacking an important component, an actual artifact to compare against. Then, in 2001, David and Joan Oates published "Nimrud: an Assyrian Imperial City Revealed" [9], which collected decades of discoveries, including hard artifactual evidence of one of the oldest parts of a pin lock ever discovered. The artifact was a thin brass plate with 3 slots and a protruding knob. This find offers a possible physical confirmation of the linguistic approach.

In a conversation with Dr. Potts, he was kind enough to direct me to the work of Dr. Karen Radner of the University College of London. In her 2010 paper "Gatekeepers and Lock Masters: The Control of Access in Assyrian Palaces" [10], Radner identifies the plate as the lock's "holding bar." Radner goes on to not only re-confirm the existence of the pin lock, but place the technology in context with the daily life of the palaces and temples of Assyria. She sets out to identify the Lock Masters, those officers of the temple who controlled the locks and keys.

In defining the official title "rab sikkāte" as Lock Master, Radner also provides a compelling argument for the pin lock having wholly replaced the door seal, further evidence that the former evolved directly from the latter.

> *I therefore propose the translation 'lock master', assuming that the crucial component sikkatu denotes--pars pro toto--the lock in its entirety. This is all the more likely as the sikkatu is the central element of the more primitive locking mechanism...Suzanne Herbordt, when studying the 565 Neo-Assyrian clay sealings from Nineveh, was unable to identify a single example for such a door sealing...This would indicate that the system was no longer in use at that time, and I would suggest that this was so because it had been replaced with the sikkatu lock.*
>
> *—Dr. Karen Radner, Gatekeepers and Lock Masters: The Control of Access in Assyrian Palaces*

So, with mounting evidence for the existence of the pin lock in Assyria, and a reasonable case for the evolution from the ancient Mesopotamian door seals, the only question that remains is when did that evolution take place? Radner mentions in her article that the terms she was attempting to define were attested in public documents at least as far back as the Old Babylonian period, around the 18th century BCE. Artifacts of door seals have been found deep into the third millennium BCE.

Lacking further linguistic or artifactual evidence, we have to be satisfied to narrow the evolution of the pin lock to Mesopotamia, sometime between 2500 and 1800 BCE.

Though this period does, rather satisfyingly, predate Denon's discoveries in Egypt, it also finally gives credence to his offhand suggestion that the locks used on doors to this day may have had their origins 4000 years ago. Redefining the origin of the lock does more than settle (or reignite) a debate in a niche community. The Mesopotamian theory provides a window into the nature of security's role in society. By following the lock back to its more primitive technological ancestors, we can begin to build a theory for not just how, but why this ubiquitous object came into existence in every society the world has known.

Acknowledgments
I owe a great deal to Dr. Daniel Potts, who's paper initially inspired my curiosity, and who's enthusiastic response to an unsolicited email set me off on an exciting path of research. My thanks to Dr. Elaine Sullivan for her aid in identifying the area Denon observed, but could not illustrate in his journals. I must also thank Dr. Karen Radner for her considered reply to my questions regarding the time gap between the last door seals and first evidence of the "sikkatu" lock. And, more personally, for sending along the cuneiform for "Lock Master":

Additional thanks to Deb Chachra, Adam Sheesley, and Julie Steele who all read, or talked through, various iterations of this work.

Citations:

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Digital Karnak project

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Lockpicking!

Picking Basics

To pick a basic pin tumbler lock you will need a tension wrench and a pick. Insert the short end of your tension wrench into the bottom of the keyway and apply a light turning pressure with your finger. Now, insert your pick. Lift each key pin to it's proper height, and the lock will open for you.

But how do you know what the proper height is? Or what order the pins set in? The solution will be unique each time. There is no set answer or specific order that will open every lock you face, instead, each lock has it's own binding order and pattern of pin heights.

Locks are riddled with tiny manufacturing defects, usually minor enough that we wouldn't notice them with the naked eye, but each difference injects vulnerability into the lock. Maybe the pins aren't perfectly deburred or have simply worn unevenly from regular use. These imperfections cause one pin to bind before all of the others. The weirdest pin out in whichever direction we are turning.

Your job is to find that first, weirdest pin. So, with tension applied, insert your pick into the lock and lift up on a keypin. If you feel it springing right back down at you, that is not your binding pin, keep moving. When you feel a pin resist you, carefully lever it up until you feel it stop. Once that pin has reached the shear line the plug *will rotate*, just a little bit, and the next weirdest pin will bind. The driver pin you've just set will sit on the shoulder of the plug that has turned beneath it.

Repeat this process for every pin in the lock. When the last driver pin crosses the shear line, the plug will turn freely for you.

Understanding why lockpicking works also reveals 3 important tips:

1) The binding order is random, your job is to discover it. If a pin is just springing back at you, that isn't the one you should be working on. Move on!

2) Changing the direction you apply tension will change the binding order!

3) Light tension! Very light tension. Think about it this way: if you apply a lot of force to the tension wrench, you'll bind several pins at once, just as though the lock were perfect. We want just enough tension to bind the weirdest pin, and not touch any of the other ones.

Even a poorly made lock can become a challenging pick if the heights of the key pins are dramatically different than one another. Conversely, if you have very little variation, your lock will usually be easier to pick. One of the most difficult problems in lockpicking is setting a very shallow pin that is right behind a very long pin. While setting the shallow pin, the shaft of your pick will often over set the long pin. The further back the high-low change is in the lock, the more difficult it will be to set.

Next up we'll look at some common pick profiles, then we'll cover tension options, feedback exercises, speed picking strategies and security pins.

HOOKS

Hooks are meant to manipulate a single pin at a time, allowing you to move methodically through the lock. With enough practice and armed with just a tension wrench and a hook, you'll be able to open most locks you come across.

Medium Hook | 
The first tool many pickers will use is your basic medium hook. This is a perfect beginner tool because it's a bit clunky inside the lock and doesn't require a great deal of skill to get the best use out of it. However, despite its simplicity it remains very effective and often enjoys a place in the primary kit of any picker as their skill advances to the intermediate stage.

Gonzo | 
Unlike the medium hook, the Gonzo has a rounded tip, allowing it to move smoothly through the lock. The tip also extends a bit higher, allowing it to better manipulate tricky high-low bittings. The Gonzo is beloved among many advanced pickers and has a prominent place in their kits.

Long Hook | 
The long hook is a beast. It is difficult to move through many keyways, can get caught inside the lock mid-pick and can be uncomfortable to work with. However, the extreme curved tip that causes all of those problems also allows it to set the most ridiculous high-low bittings. Though this pick rarely sees regular use, it has proved itself to be invaluable in a few specific situations, so some pickers keep it around.

Deep Curve | 
The deep curve is the most widely borrowed member of a family of tools called the Falle Curves. The deep curve is my favorite part of the larger system and makes an excellent solo tool. By allowing the belly of the curve to run along a low point in the keyway & rocking the pick into the lock, following the line of the pick head, you get a great sense of control and can easily manipulate difficult to reach pins in the back of the lock.

Notched Hooks | 
The most common notched hooks tend to fall somewhere between the medium hook & the long hook in height. However, you can carve a notch into any pick you like and enjoy the benefits. Simply, the notch makes it easy to locate each pin inside the lock and in the rare situation where heavier-than-normal force is required you don't risk slipping off of the pin you are working on as you would with the Gonzo or medium hook. Finally, in locks with oddly shaped pins, such as Medeco's chisel tipped pins, the notched hook allows you to manipulate them in more specific ways, such as rotating them.

DeForest Diamond and Ball | 
These days the picks named for Bill DeForest are more likely to be sold under the name "offset diamond" or "offset ball," but I think it's worth keeping the traditional names in circulation. The DeForest diamond is usually my second pick in a lock, right after the Bogota, which is covered in the rakes section. The angled end of these picks gives the deforest a deeper reach than your typical hooks and the added shape to the tip, whether ball or diamond, allow you some additional manipulation options. My primary use of the Deforest is to defeat high-low bittings. The Deforest moves through a lock with ease, unlike the long hook, but can set the more extreme high-lows that the Gonzo can't quite reach. Though you will rarely find them in starter sets, a Deforest should be one of the first picks you make or acquire after you get comfortable with your initial tools.

RAKES

Rakes are a contentious topic. They are meant to manipulate several pins at once and as a result they can often open locks very quickly, but rakes lack the consistency and range of hooks. Some people think of rakes as a shortcut, but I believe in learning how to use any tool you may come across. A word of caution, though. When you first start picking, try not to rely on rakes. The more you develop your single-pin-picking (SPP), the better you'll perform with any pick.

C Rake |
The ever-popular "snake rake" or "c" rake. This diminutive, narrow profiled rake that is found in nearly every starter set, is all but useless against decent locks. It will pop Master Lock #3s like magic, but that's about it. Eventually, once you learn to use and love the other tools on this list, it will fall into disfavor and out of your primary kit.

S Rake | 
A lot of pickers love the S rake. It's not my go-to, but it may give the best feedback of the rake family. With only 2 peaks there isn't much extraneous information being fed to your fingers. The angled sides and valley of the pick profile allow it to move very smoothly through the lock. However, the sharp angle just before the pick head makes it weak and prone to snapping by heavy handed pickers.

Large S | 
Less common, but a whole lot more interesting is the Large S. It is best used with very light tension and a quick pushing motion. "Push, Push, Open!" as I was told by the German picker who convinced me to buy my first. You may find you prefer a different approach, but no matter how you use it, the Large S will set a wider variety of bittings than either the C or S.

L Rake | 
The L Rake is the longest of the bunch and will likely interact with every pin in your lock at once. The L rake can pop locks all on it's own, but I've used it to great effect in speed picking difficult bittings. I apply light tension & rake low in the keyway to hopefully set some of the longest pins, then, I increase tension a little bit and go back in with a Gonzo or Deforest diamond to finish the shallower pins off. A basic, but very effective speed picking strategy.

Bogota | 
The Bogota rake is the sole creation of Raimundo, though his pick has been poorly reproduced by many of the major manufactures in the last few years. The classic instructions for this pick are to hold it like a tiny gun, then shake it in the lock like you've been drinking too much coffee. Personally, I employ a more delicate touch, but whatever way you use it, the Bogota will open a wider range of locks than any other rake I've ever seen. When I compete, this is my first pick in the lock.

BALLS AND DIAMONDS

Half Diamond | 
The half-diamond is one of the only tools that remains wholly unchanged in a pickers primary kit from the day they learn how a lock works to the day they win their first competition. Half-Diamonds can be found in 3 basic sizes, small, medium and large. The small diamond will fit through very narrow keyways with ease, but won't effect much inside, the large diamond's long, ramped sides can be incredibly useful, but near impossible to move in tight keyways. Right between them, then, we have the medium diamond, which moves through the lock well and has enough of a slope to be quite useful.

They move so smoothly across the pins, and are wide enough to manipulate 2 at once, but still have a defined tip that can move a single pin at a time. But, the real value of the half-diamond comes from the sloped sides. In situations where you need to move a pin very little, or when you have to apply lighter tension than normal, a half-diamond is your best friend.

Balls | 
Balls come in a few different shapes. Most popular is the half-ball, followed by the snowman, or double ball. All of these picks are most commonly used on wafer tumbler locks . The gentle curves of the ball family are ideal for moving smoothly along the hard right angles of the wafers. A half-ball will be used against a single-sided wafer lock, and a double-ball or full ball will often be used against a double sided wafer lock.

PROFILE PICKS

Profile picks are an altogether different concept. Rather than actively manipulating the pins, the profile picks set all of them to a specific configuration, then test the lock. This is the brute force attack of lockpicking and as such, the strength of the attack comes down to the size of your pick set.

"High Tech" or "Computer Generated" | 
The Majestic "High Tech" pick set has 16 individual heads, each of which can be used in either orientation in the lock, giving you 32 profiles to work with. By bouncing (applying and releasing) tension while you slowly move these picks in a figure 8 motion in the lock, you may well find the shear line. By trying the profiles at different heights and angles you'll cover a huge range of bittings, one of which is likely to match the original key.

King and Queen | 
On the other end of the spectrum you have the King & Queen. These 2 pick heads can only be used in one orientation, so you are limited to 2 profiles. Used by themselves they are incredibly ineffective. However, their profiles are so dramatic that they make a great addition to a well rounded pick set. When you are up against a very aggressive bitting that is proving too difficult to pick with conventional tools, try taking a run at the lock with the King or Queen. It's the hail Mary pass of lockpicking, and when it works, it's amazing. Never be tempted to rake with profile picks of any sort, as their sharp angles and dramatic variations in height make them prone to catch and even snap inside the lock. Be gentle with this attack.

TENSION OPTIONS

With so many picks to choose from, people often forget how important tension is.
While a standard bottom of keyway tension wrench can get you far, it's worth exploring other options. Even adding a twist to a standard wrench changes how it behaves. If you need firm, even pressure, use a simple, 90 degree bent wrench. Add a twist and you add flexibility, which allows you to apply a wider range of force to the lock.

Feather wrenches go a step past the twist and put a spring before the head of the wrench which dissipates most of the force you apply. The idea is to provide the lightest tension possible, which some pickers prefer when attacking security pins.

While you won't find them from any manufacturer, some pickers modify their wrenches into a stepped pattern that fits more snugly at the very bottom of a keyway, without colliding with the

housing which can give a false sense of binding.

Top of Keyway (ToK) wrenches are similarly hard to find from any major pick maker, but are essential to any picker's kit. This tension wrench has a shorter head than the common bottom of keyway wrench, as you don't want it interacting with the first pin in the lock. I would also suggest adding small serrations to the edge, which will help keep the wrench firmly entrenched in the keyway. Applying tension at the top of the keyway provides a more central turning action on the plug, which will improve feedback from the pins, and it gives you much more room to work with your pick, as you aren't cluttering up the open portion of the keyway.

When it comes to applying tension, experiment. Always start light, but changing the amount of tension you apply will change what you feel in the lock with the pick.

WHAT TO LOOK FOR IN PICKS

The number of pick manufacturers has ballooned in recent years, and as a result there has been both exciting innovation and an influx of terrible, cheap tools. Here are a few tips for buying your first, or next, set of picks.

Handle Material

The recent trend of plastic and rubber handles should be avoided. The more directly your finger contacts the plain metal of the pick, the better you can feel what's happening inside the lock. That feedback is essential, and most of the tips here will be concerned with maximizing feedback. While you may find a bare metal pick is too painful on your fingers to use indefinitely, I would recommend you suck it up, develop the calluses and embrace bare metal. However, failing that, at least use metal handles. Even thickening up the handle of the pick with a sandwiched metal plate can make the pick dramatically more comfortable. A good homebrew option is applying some heat shrink tubing — available at most hardware stores— to a bare metal pick. This will be much more comfortable on your fingers, but won't deaden feedback too badly.

Metal Selection

What matters most is that the manufacturer cares about the metal they use in their picks. If it seems like they haven't put any thought into it, be wary. Generally you want spring or stainless steels, but there are a lot of good options among those two metal types. From Peterson's "Government Steel" to Southern Specialties 1074 Spring Steel picks, what matters is that the pick maker cares enough to get the metal right. If your picks have no shape memory —if they don't return to their original form when bent— they're going to be all but useless.

Full Body Tang

As any chef or sword fighter knows, when it comes to blades, the tang —the part of the blade that extends into the handle— has to run all the way through the handle. If the blade of the pick doesn't continue unbroken all the way through the handle, you'll lose feedback. There are a number of picks being made now, such as the SouthOrd MAX Yield line, with plastic or rubberized handles where the blade only occupies .5-1" of the handle.

Finishing Your Picks

Whether making your own picks or buying commercial picks, you should take some time polishing them with sandpaper before you use them. The smoother the pick is, the easier it will move through the lock and the clearer the feedback you'll get from the pins. Even just using some metal polishing steel wool can make a dramatic difference.

There are many more picks out there, but most are just variations on a theme. There are very thin, flexible hooks meant for tight keyways, towering half-diamonds for delicate high-low bittings, and a mind-numbing collection of different rake profiles. Understanding the basics will let you infer the best use of each new pick you come across.

Exercises for Developing Feedback

Feeling what is going on inside of the lock is a skill, and one you have never had to develop before. The tactile feedback you need to discover the topography of a lock as you pick it is extraordinary, but absolutely learnable. The first several times you open a lock, you probably won't know what you did to get it open. That's OK! That's how this works. You'll slowly discover the touch, but if you do these simple exercises early on it will speed up your development.

1: With no tension applied to the plug, take your hook pick and just press up against the key pins. Feel them springing back at you. While it is difficult to convey the feeling of a binding pin, it's very easy to demonstrate what a pin feels like when it is not binding. Repeat this several times on various locks when you are starting out to get the feeling. Then, when you are actually picking and feel that free spring pressure on your pick, you'll know to come back to that pin later and move on to the next.

2: Take a lock with only 2 pins in it (you may have to remove pins from another lock). Apply some light force to your tension wrench and pick the lock, over and over and over again. All you are trying to do is feel the difference between a binding pin, and a free pin. This can also help you get a handle on your tension weight. If you find both pins seem to be binding at once, lighten the pressure on the wrench. You should also try changing the direction you apply tension and see if the order the pins bind in changes.

3: With no tension applied on a fully pinned lock, take a nice hook pick, insert it at the top of the keyway, and run it into the first pin in the lock. Once you've collided with that pin, slide the tip of the pick down the pin, slide forward just enough to lift that pin all the way up, then push forward into the second pin. Do this again to get to the third, fourth and so on. Once you have all of the pins lifted up, slowly pull your pick out of the lock and try to feel as each pin drops off the back of your pick one by one. The goal is to develop a sense of what pin you are working on, and exactly how deep in the lock you are working.

Speed Picking Strategies

If you get to the point of picking competitively, you'll develop your own methods for opening locks quickly. Some of the most talented competitive pickers I know just stick to a tension wrench a few hooks. Watching them pick head to head is mesmerizing, as they tend to be very calm and still, just methodically setting pin after pin, using their technique and touch carry them to victory.

For those of us (myself included) who fail to maintain any sort of composure while picking against the clock, there are some simple strategies worth trying.

Mixed Method Picking

Rakes can be powerful and fast as they manipulate several pins at once, however, there are a lot of locks they just can't open. The more extreme the bitting of your lock, the less likely a rake can open it by itself. However, if you allow the rake to work in the lock for a few seconds under very light tension, then switch to a hook, you may find that the rake did most of the work for you and now you

can finish off the remaining pins quickly with your hook. Switching between tools while keeping tension on the lock is a classic strategy, and for speed picking, one of the most effective.

Cascading Attacks

I like having a variety of tools and techniques at my disposal for speed picking, but more important is having a plan for how I'll employ them. The first competition I ever participated in was the Dutch Open. In the Open you pick in 7 minute rounds, so I developed a 7 minute cascade of attacks.

0:00	Clockwise (CW) tension + Bogota Rake
0:15	Counter-clockwise (CCW) tension + Bogota
0:30	CW tension + mixed method, usually Bogota + DeForest Diamond
1:30	CCW tension + mixed method
2:30	CW/CCW tension + Single Pin Picking
5:30	Mixed method, L or S Rake + Gonzo
6:30	King & Queen

The Bogota manages to open more locks than most other rakes, and it's a joy to pick with, so it is always my first pick in the lock. If the Bogota doesn't open a lock for me immediately, I'll try applying tension in the opposite direction. From there I'll switch to a mixed method attack, starting with a few swipes of the Bogota or L Rake and then going in with a DeForest Diamond or Gonzo to set anything that was left behind. Next, I'll set the rakes aside to focus on single pin picking. This may employ just about any hook or half-diamond in my set. Hopefully by this point I've at least gained a vague sense of the topography of the lock and can use that information to make my methodical picking go a bit faster. After ~3 minutes of this I'll go back to my mixed method picking, employing a few different rakes in the process and, if all else fails, with 30 seconds left on the clock, I'll employ the King & Queen picks.

Having a cascade gives you focus when you are picking, and can stave off frustration. As long as there is always something else to try, I can forgive myself for not opening the lock, yet. Sticking to my cascade helps me keep calm in a tense situation. However, you can't be rigid. If you discover something while picking that makes you want to break rhythm, don't be afraid to follow that instinct. It's those insights, more often than strict adherence to your cascade, that will get you an open lock.

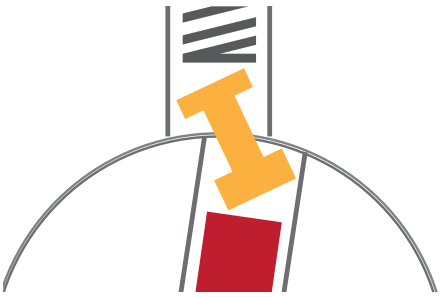
Security Pins

Security pins are an easy way for lock makers to improve their defense against surreptitious entry. Like picks, there are a variety of security pins out there, but we're going to focus most of our attention on the 2 most common, Spool and Serrated pins.

Spool Pins

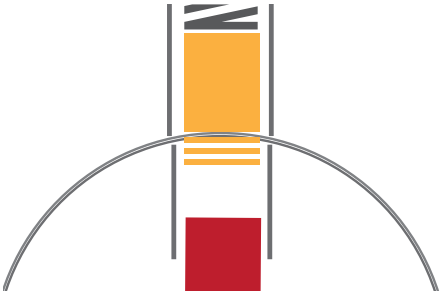
The classic spool pin looks as it is named, like a spool. There is a large section of the middle of the pin that is a smaller diameter than the top or bottom. With that much material missing, the spool pin will typically be the last pin to bind, and when it does, it will feel like you have picked the lock. The middle section of the spool pin will catch on the shear line, as the bottom tries to turn with the plug and the top is stuck up in the bible of the lock. The effect on the picker is that the lock feels like it has opened, then suddenly stops after turning only a few degrees. This phenomenon is called a "False Set."

To overcome a spool pin, you first have to find it. When you enter a false set, lighten your tension, and grab a simple hook pick. Press upward on each pin in turn, if the pin raises up, then stops dead, it is running into the side of the pin chamber, not a spool pin. When you find the spool pin, you'll feel the plug counter-rotate against your tension wrench, slowly turning back to 0 degrees. That is the bottom of the spool pin passing across the shear line. Keep light tension and raise it carefully. If you are lucky, once the bottom of the spool pin has crossed the shear line, the lock will open for you. It is also possible that some of the other pins you had set previously will slip off of the shear line, but so long as you have that spool set, it should be easy to reset the pins that have fallen.



Serrated Pins

Unlike the spool pin, it is not immediately obvious that you have become trapped on a serrated pin, and discovering which pin it is harder as well. If none of your key pins are under spring pressure —if each of them are just resting in the plug, not in contact with their driver pins— but the lock hasn't opened yet, you may be caught on a serrated pin. To test, lighten tension and gently push up on each pin. If you get a distinct "click" out of one of them, but the key pin falls back down again, that is likely the serrated pin moving up one position. Keep tension light, and gently bump that pin up until it has crossed the shear line.



If you have a serrated driver pin sitting above a serrated key pin, it is very easy to push too far and get your key pin irreparably caught on the shear line. The only solution then is to drop tension and start over. In this situation, the half-diamond is your best friend. When you have light tension applied and are moving a pin incrementally, you want as much control over the amount of force being applied to that pin as possible. If you are using a levering motion on a hook, it is hard to regulate that force. With a half-diamond, you can move horizontally through the lock, pushing the pick forward and allowing the key pin to ride up the slope of the diamond. You have much more control and can easily stop yourself from over setting the pin.

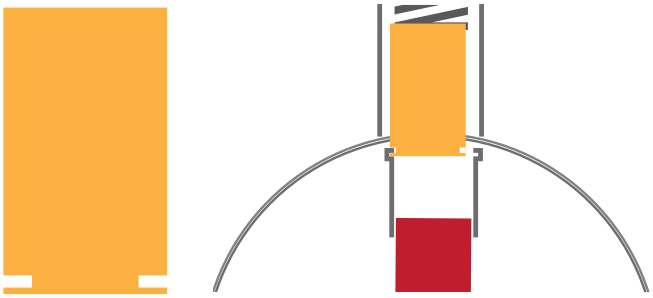
Mushrooms, Donuts, Torpedoes, and More

There are many clever variants of spool and serrated pins. The simplest is the serrated spool, or "spoorated" driver pin that can be found in many American brand padlocks. These look just like traditional spool pins, but have a single serration cut along the bottom of the pin, so that after recovering from a false set, you'll get caught up on the serration.

A common variation on spool pins that you can find in Medeco and MX locks, among others, are Mushroom pins. The material removed from the middle of these pins is tapered, going from a skinny base up to the full width of the pin. Mushrooms aren't as common as spools because they require precise loading in the lock. While a spool pin can be dropped into place out of a hopper and work in either orientation, mushroom pins must be loaded with their taper facing downward. This small difference increases assembly costs, so few manufacturers use them.

Another victim of the high costs of manufacture are DOM's clever Donut Ring pins. DOM started with a simple spool pin, but added a free floating brass ring to it. The feeling of picking past these movable rings is unique and confusing when you first come across them. Unfortunately, compared to a standard pin, or even a normal security pin, the ringed spool was too expensive to produce and DOM have ceased manufacturing them.

Security pins aren't just for drivers, either. Many key pins have similar features, most designed to catch the key pin above the shear line if you accidentally lift it too far. That's the goal of the Torpedo pin, which is the key pin equivalent of a Mushroom. The lip at the top of the pin easily catches above the shear line when overlifted. Recovery at that point is unlikely, and you'll have to release tension, let the pin drop back down, and start over.



ASSA has a brilliant pin that actually interacts with a simple modification to the plug of their Twin Combi locks. In 2 of the pin chambers in the plug there is a small shelf cut into the chamber wall, just below the shear line. Just above the bottom of the driver pin that sits in these chambers there is a small, precise channel milled out along the circumference. When one of these pins binds, and you start pushing it up into the bible of the lock, the channel and the shelf will marry into one another, forming a tight connection. It will feel just as though the pin has set, and discovering it is incredibly difficult, much less correcting for it.

The amount of variation possible within the confines of the simplest pin tumbler lock hints at the depth of mechanical ingenuity to be found in all aspects of lock engineering and lock picking. For each additional security measure a lock maker implements, a new tool or technique is developed to counter it. For each new attack, a new feat of mechanical engineering to restore the security of the cylinder. Both sides of the study of locks provide endless fascination.

But wait...there's more!

Hopefully you enjoyed any of this. Honestly, it wound up being a bigger project than I expected. Of course this isn't absolutely every piece of content I've ever produced, but you can find a lot more by looking for me at the following (reasonably short) links:

All of my material that doesn't translate well to text can be found at:
https://youtube.com/schuylertowne

I don't check in often enough, but I do sometimes try to answer questions at:
http://www.quora.com/Schuyler-Towne/answers

I check r/lockpicking now and then to see if anyone needs a weird lock question answered. You can look through my posts here:
http://www.reddit.com/user/schuylertowne/

I try to get a letter out every now and then via TinyLetter:
http://tinyletter.com/schuyler/letters/

You can also find most of my slide decks here:
http://lock.gd/talks

I'm always up to talk locks on twitter:
http://twitter.com/shoebox

And, of course, you can find my research projects and blog posts at:
http://schuylertowne.com

Thank you for supporting this project so long ago, and thank you for reading through this collection. I hope you've found it interesting!

-Schuyler