#29 March 2022

Green Thoughts

Conversations and ideas about growing at The Spring Gardens

In New England there is a tradition of planting pea seeds on St. Patrick's Day, 17 March. In most places up there the soil doesn't become workable until then. Here in Philly our growing season begins much earlier.

Starting Peas

Most years I plant my pea seeds in the ground in mid-February so they get an early start before the hot weather of June descends on us and limits the harvest. This year the winter in Philly was wet and the top layer of soil stayed mostly frozen. Even though the soil had thawed by mid-February, it was still muddy. In eastern Europe the late winter mud season is the norm so they have a name for it "*rasputitsa"* or распутица in Cyrillic. Not a good time to send an invading motorized army into another country when they can only move along paved highways. They can't scatter off highway because they would get stuck in the mud and would be sitting ducks. In eastern Europe usually there is another rasputitsa in late fall.

The Latest in Subsidence

Pea Progress

Despite the mud, I wanted to start my peas in mid-February so I did the old trick of germinating my pea seeds indoors between layers of damp paper towel surrounded by plastic wrap. Most of the seeds germinated (see above). The germination rate was better than when I plant the seeds directly in the soil. The germinated seeds produced the beginnings of roots, those long, white appendages, and the first sign of green shoots. I planted the germinated peas into flats (above right) where they produced their first regular leaves. When the soil dried out in TSG, I transplanted the seeds into our garden plot. By the day after St. Patrick's Day the pea plants looked sturdy and robust (see next page on top). And I was off to the races. Especially since I also had robust spinach, lettuce and pak choy that I had planted in late fall.

snow peas in the ground and on the rise on 18 March 2022

Subsidence Chronicles Continue

As readers of previous issues of Green Thoughts know, we have been beset by chronic sinking of the southeast part of our community garden. That is the area of most concern although the northwest area also has subsidence. In this issue we'll bring in new data and supplement that with old observations on topics as disparate as what happens in hour glasses and the interesting case of the construction of the Brooklyn Bridge. Trying to figure out what is really going on is a great spectator sport. We encourage all our readers to tell us what you think about what is causing the subsidence and what is the easiest and most economical way to mitigate subsidence in our beloved community garden.

First let's begin with an old calypso song that Harry Belafonte used to sing. Here are a few lyrics:

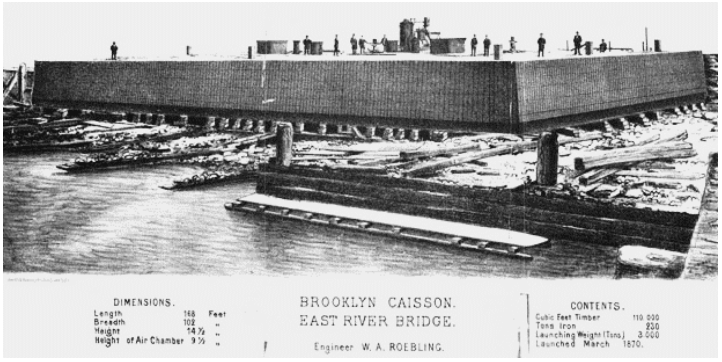
House built on a weak foundation
Will not stand, Oh no
Stories told through all creation
Will not stand, Oh no
Rain come wash it down (Ha-ha)
Sun come burn it up (Ha-ha)
Storm come blow it down (Ha-ha)
This house could never be, Oh no
It would be weak, you see

House built on a rock foundation,
It will stand, oh yes
Stories told through all creation
It will stand. Oh yes
Rain come wash on it (Ha ha)
Sun come shine on it (Ha ha)
Storm can't blow it down (oh no)
This house will always be (Oh yes)

In its own way the song is a truism but is it true? Really and truly? We present the Brooklyn bridge as a counter example:

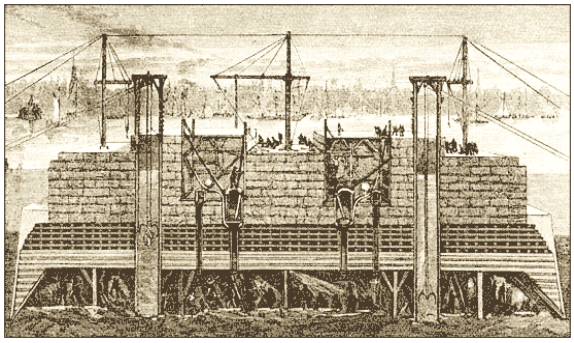
Historical photo of Brooklyn Bridge from about 1900. Manhattan to the left Brooklyn to the right

The Brooklyn Bridge was conceived to carry traffic over the East River between New York City and Brooklyn, then a separate municipality. Until the bridge was built the only way to go between the cities was by ferry which was inadequate given the volume of traffic. John Roebling was the engineer who designed the bridge. He had already designed and built small suspension bridges including one over the Ohio river at Cincinnati. The Brooklyn Bridge would be much larger. He also owned a company that manufactured strong steel cable that could carry heavy loads. His notion was to build two stone towers about one third of a mile apart (about 1600 feet) and string cables between the towers so the bridge roadway would be suspended below the cables. The trick was to build very sturdy masonry towers that would be lying on bedrock below the river. Underneath much of Manhattan Island the bedrock is schist, a metamorphic rock that has been around for 100s of millions of years. The bedrock is mostly located between 15 and 40 feet below the surface, but it varies a lot more than that. It is stable and strong and can support heavy loads. The towers had to be placed in the East River itself rather than on the adjacent land in order to keep the distance between the towers as short as possible. The greater the distance, the taller and more expensive the towers would have to be. Underneath the towers would be caissons, large wooden structures that could be sunk further and further into the river until they reached the bedrock. The caissons would then be filled with concrete and the stone masonry towers would go on top. See an illustration of the caisson above right. They were quite large 168 feet long by 108 feet wide and 14 feet high. The caissons were open at the bottom. John Roebling, while working on site trying to decide exactly



where to put the caissons had his toes crushed in a pier when a ferry came for a landing. He had several toes surgically removed but then got tetanus and died 10 days after the accident. His son Washington Roebling, also an engineer was appointed to take over. The caissons were fabricated nearby and floated to the necessary positions. They would start out sitting on the mud of the river bed and there would be special tubes that would take workers from outside so they could get inside and dig out the mud and muck below them. The air inside of the caisson was pressurized so that water and mud outside would not seep into the caisson.

As the caisson sank the air pressure had to



Drawing of the work operation inside the caisson as men dug. Pumps maintained the air pressure while tubes with airlocks allowed workers to get inside and out of the caisson. Other tubes removed the mud and silt. Meanwhile masonry was piled on top of the caisson to form the tower.

increase. There were many hitches but the Brooklyn caisson eventually was anchored to the bedrock. The Manhattan caisson was

more problematic. It had to go deeper than the Brooklyn caisson because bedrock was much lower. The workers started suffering a new ailment which initially was called caisson's disease. They were okay as long as they stayed inside the caisson but when they came to the surface they had terrible pains in

A photo of the work inside the caisson. It was hot and humid and had a distinct stench

their joints and other parts of their body. They doubled over in agony so the disease was popularly called 'the bends', aka decompression disease. Washington Roebling himself came down with the bends and was so incapacitated that he couldn't work on site. He watched the operations from an apartment facing the river. His wife Emily Warren Roebling became the field engineer for the project. This is all very interesting but *what does this have to do with subsidence in the southeast corner of The Spring Gardens?* Washington and Emily realized that worker mortality and severe chronic injuries would only get worse as the Manhattan caisson was sunk further. They decided the caisson should go no deeper. It would have to sit on mud and sand. The caisson was filled with concrete, the tower rose up on top of it and despite a downward pressure on the caisson estimated to be 45 tons per square foot, the tower has been stable for the last 139 years!

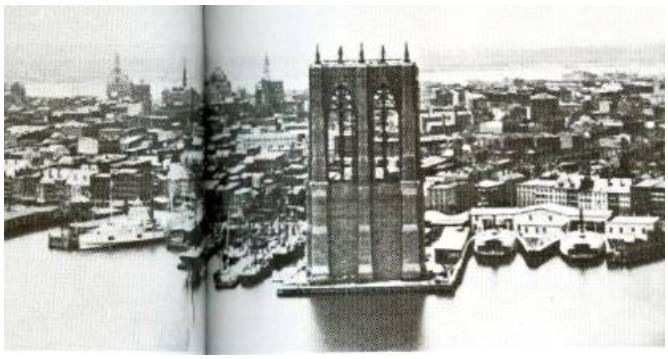
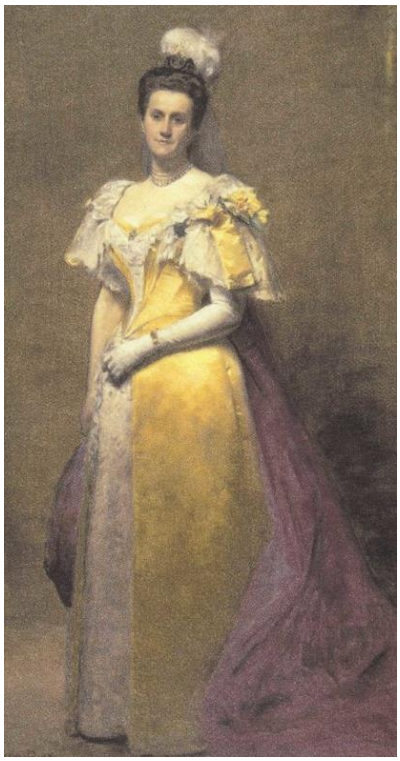


photo of the nearly completed Manhattan tower. East River in foreground, Hudson River in the background

I don't want to rub it in, but the tower is not on a rock foundation (Oh no). And this may help us think about how to stop subsidence. Let's file that notion for the moment.



Emily Warren Roebling.1843-1903 "I have more brains, common sense and know-how generally than have any two engineers civil or uncivil" At the opening of the Brooklyn Bridge May 24, 1883, in the presence of U.S. President Chester A. Arthur and future President Grover Cleveland, because of her essential work on the Brooklyn Bridge, she was chosen to be the first person to cross the bridge…She was accompanied by a rooster. Painting by Carolus-Duran

Looking through the hour glass

Let's look at the problem of subsidence from a very different, much simpler view - the hour glass. It has been around for hundreds of years and basically it consists of two conically shaped glass containers sealed together at their tips with one container on top of the other. Between the tips is a small opening so that sand (or other granular material) in one container can flow into the other container. Depending on the amount of sand and the diameter of the opening, it will take a fixed interval of time for the sand to empty from the top container and end up in the other container. The classic interval is an hour, hence the name. We have an egg timer in our kitchen where the interval is 3 minutes. We are not interested in boiling eggs but looking at the surface of the sand in the upper container as it empties into the lower container. The sand doesn't form a hole over the opening but the top surface from center to side becomes concave.

Back to Facts and Data

What is going on beneath the surface in the southeast part of the community garden? It was decided to dig some holes in one of the plots that had been sinking. Instead of drilling a hole, a Bobcat manned by contractor Con dug out a portion of the plot. He carefully skimmed off the top, which contained very good topsoil, and piled it up. And then dug below where there was an orange-colored clay substrate, the same as was seen in digging up the east-west paths.

Excavation of part of a plot near the southeast corner. Topsoil was removed and clay substrate is below

But then Con discovered something interesting about 4 and a half feet down: a horizontal slab of concrete (orange dashed area below). It was recognized as the likely floor of the basement of the house that once stood above there. Con felt that the slab is probably in the same position as it was from the beginning. All present agreed. If other similar excavations were made nearby we would find slabs from the basements of adjacent houses and in their original locations. Now all we have to do is figure out why this whole southeast area is sinking. Contrarily, some have thought that the sinking was due to compaction of fill into the voids of basements that were no more.

But let's examine that. Compaction should have been completed many years before, the slabs are only four or five feet below ground level. Further, when the houses were demolished the areas *not* over the basements should have been untouched. So if we buy into compaction as the cause of subsidence we should find crater-like concave surfaces over each basement. A scattering of craters. But that is not we find. The whole area is sinking but the slabs haven't moved. A puzzlement.

A speculative suggestion

Jerry Lettvin, a friend, colleague and mentor used to say, "you have to know the facts before you can pervert them." So here are what we think are the basic facts and tentative conclusions:

- The southeast corner of The Spring Gardens has been sinking since the beginning, 1995.
- Topsoil has been added to the various plots year after year in a volume that exceeds the volume of the basements that were once there.
- There must be something below carrying away the material because there is no sign of erosion at the surface.
- There is indirect evidence of subterranean stream beds in Spring Garden that could be the vehicle for carrying away soil.
- We get an average of about 3.5 feet of rain each year. Or about 85 feet of rain in a 25 year period. Much of the rain is carried off in storm sewers and run-offs in streets but the rest feeds the underground stream beds.
- The whole area is sinking not just over the basements. It looks like we could model what is going on as if we have the top half of a giant hour glass filled with clayish soil instead of sand. So the sinking takes place over years rather than minutes.
- Horizontal concrete slabs remain stable despite the sinking just like the Manhattan caisson of the Brooklyn Bridge.
- In most places where there are underground stream beds the overlying ground is stable enough to let the water flow through as if it is going through a tunnel.
- In some places there is a soft spot in the overlying ground, like the hole in an hourglass. That is where the cavitation begins. The clearest nearby example of cavitation is a small area of deep center field of the baseball area in Roberto Clemente Park (which has been there since 1970). That small area was filled two years ago and is sinking again.
- The soft spot for the cavitation of the southeast area of TSG is likely where the sinking is deepest, just like in an hourglass. And that is the extreme southeast point of the Gardens or slightly beyond there.

A proposal

Given what we have said above, we suggest putting in a horizontal concrete slab approximately 10 feet by 10 feet right in the extreme southeast corner of the gardens three feet down. It should remain stably in place. Also, it would act as a roof to turn that part of the stream bed back into a tunnel. We suggest that the subsidence should stop or be severely attenuated.

So what do you think?

Green Thoughts welcomes other points of view in how to deal with subsidence…

Please send your ideas, thoughts, suggestions and observations to:
e.gruberg@temple.edu
that address can also be used for getting on the mailing list for Green Thoughts, or getting off.

Prepared by Ed Gruberg

Most back issues and a partial index of Green Thoughts subjects can be found on The Spring Gardens Website under Resources