MAGDEBURG HEMISPHERES

A Sermon by the Rev. Dr. Arthur M. Suggs
Preached on Youth Sunday, June 22, 2014

As you may have already guessed, we have something special for you today. It's Youth Sunday, and several aspects of the service will be a little unusual, so we will have to remain flexible. This is probably the first time our communion table has ever been blessed to receive a vacuum pump.

"Not by Might, nor by Power,
But by My Spirit"

What I want to talk about for today's sermon is the power of spirit. Of the two scripture readings, the first is from the very beginning of the Bible in Genesis 1: 1-2, where it says, "And the spirit of God was moving over the face of the waters." In a sense it's a mystical passage, but it implies that creation took place via the power of the spirit.

The second reading (Zechariah 4: 6) tells an interesting history, mostly having to do with the situation around 2,500 years ago, when Israel was stuck in a lousy environment in terms of the politics of the time and the ongoing wars. The prophet Zechariah simply advised the king to stop emphasizing his armies and to stop stressing the political alliances between the Assyrians and the Babylonians and the Egyptians. Instead he quoted the word of the Lord, "Not by might, nor by power, but by my spirit." That is the way you will heal your country.

It's advice that countries have tried to emulate throughout the centuries, some with more success than others. Now "spirit," both in Hebrew and in Greek, is a word that is linked to other common words, namely "breath" and "wind." (In Hebrew it's "ruach," in Greek it's "pneuma," from which we get "pneumonia," having to do with the lungs.) What it means is "spirit," yes, but it also means "breath," and without breath, you're not alive. Thus "spirit" is intimately linked to being alive. It also means "wind," everything from a breeze to a hurricane.

Making a Marshmallow
Rise Like a Baking Muffin

What I want to do now is to demonstrate the power of wind or breath for you and to have a little fun at the same time. I'm going to do it by taking your breath away, so to speak. That may sound strange. So kids, would you please come up and move around the special equipment on the communion table. Thank you. [Youths approach the communion table, which holds a vacuum pump and rubber hose, bell jar, two hemispheres, two cups of water, and a bowl of marshmallows. – Commentary in brackets supplied by Deus ex machina.] First I'm going to ask you to do a scientific test for me and make sure these marshmallows are real. Everybody have

one. Now I want you to tell me if they're real. [A hungry chorus pipes up. Yeah, they're real.] Okay. They're the real thing. All right, this cumbersome little machine is a vacuum pump. It can take the air or atmosphere out of an enclosed space.

How high up does our atmosphere go? Into outer space? How many miles? About 3,000? 10,000? Any other guesses? Okay, several miles. And the air gets thinner and thinner the higher up you go. That's why military pilots wear oxygen masks when flying at extremely high altitudes. Now gravity is pulling down on that air and keeping it against the Earth. So does the air weigh anything? No? Not in outer space. A good answer. But here on earth, it does weigh something. A column of air about one square inch wide, like a marshmallow [Pointing to the top surface of a marshmallow], going straight up, say, 30 or 40 miles, weighs just over 15 pounds.

A One-Inch Marshmallow Full of Air
Pushes Back on Miles of Air

So why doesn't this marshmallow get crushed if it's got 15 pounds pressing down on it? Why doesn't it get crushed? The reason is because within the marshmallow, there is air at a very high pressure, sufficient to match evenly the weight of air above it and keep it from being crushed. Now I'm going to remove that pressure and watch what a marshmallow would naturally do if it outweighs the air above it. And now we put the marshmallow under the bell jar and close this valve, and I think we're ready to go. Let's turn the vacuum pump on. Here, let me come around to the side a little, so **I'm right by the switch in case something blows!** [Turns on the vacuum pump. Air is sucked out of the bell jar, reducing atmospheric pressure within it.]

Any change in the size of the marshmallow yet? Is it getting bigger? Yes, it is! [The marshmallow grows larger.] And now I'll let it go back to its original shape. Let's see if it gets smaller, as it was before. I'll let the pressure out slowly. [Opens the valve slowly, letting air under atmospheric pressure back into the jar.] I don't want to blow things up. And it went back. [The marshmallow returns to its original size.] So that's what air pressure can do. That's just a demonstration, though. Now let's see if the marshmallow is still edible. It went back almost exactly to its original size. Go ahead and eat it. [A youth gingerly eats the marshmallow.] And if you live, ***if you live!*** we'll know that it's still okay to eat.

Water "Boils" on Losing Air Pressure
But with no Rise in Temperature

Now here is another experiment for you young scientists. Okay, would you hold this for a second? [A youth holds the bell jar.] It's heavy; do not drop it. Here is a cup of water. Okay, some of you put your finger in this water, and tell me on a scale of one to ten – one being icy, ten being boiling hot – what temperature is it? [Extends cup of water. Youths dip fingers in cup to test water temperature.] Four? What do you think? Eight? Three? Two? And what do you think? Four? Seven? Okay, so anyway it's someplace in the middle. It's not boiling, is it? And I need this back. [Places cup under bell jar.] Thank you. Okay, I just figured out why the marshmallow didn't blow up real fast.

Okay, we close this valve, and now gather around closely. I want you to tell me if you can see the water boil. [Turns pump on. It sucks out air from the bell jar.] Is it getting warm? There it goes. Look. [Water in cup is bubbling.] Okay, so now we've got it "boiling." And I'm going to turn the pump off. [Turns off the vacuum pump.] Here I've got to be very careful because I don't want to spill the water. Got it? I'm going to let the pressure back in very slowly. [Turns valve very slowly.] You can see a cloud forming inside the jar.

Let me get access to the cup again, quickly please. [Removes cup from under bell jar.] And I put this over here. **And I accidentally spilled some! Oh my gosh! Are you burnt?** [A small voice says, "No. It's just cold."] Wait a minute, isn't it any hotter? How can that be? You saw it "boiling." What happened is that it never changed temperature at all. But the pressure, that miles and miles of air above us, pressing down, keeps this from boiling naturally. So if you were in outer space, and you got a leak in your space suit, what would kill you? But be more specific. The lack of pressure in space would allow high body pressure to force blood through the vessel walls into the vacuum of space, thus simulating blood "boiling." And that's what would kill you if you were in outer space, and your space suit gets cut or compromised in some way.

Lacking Air, Magdeburg Hemispheres
Are Defeated by Air Pressure

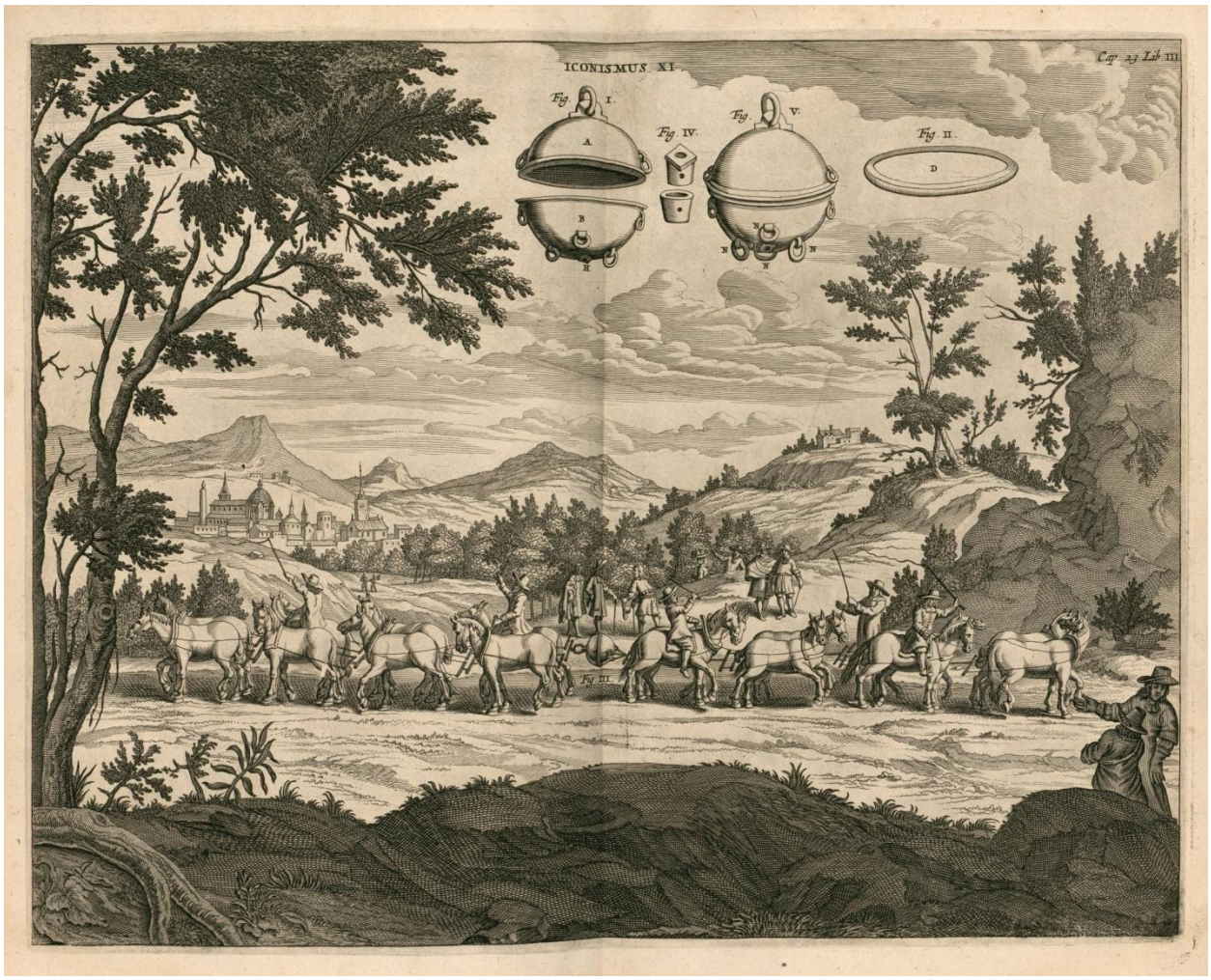
Here's one more experiment I want to show you. [Turns to the hemispheres lying on the table.] These are representative of hemispheres made in the 1600's, about three-and-a-half centuries ago. They are called Magdeburg Hemispheres, named by Otto von Goerke, who was the mayor of a little town in Germany named Magdeburg. He had theories about the way in which air pressure worked, and to test them, he created a pair of half-spheres, called hemispheres, just like this, but they were made out of copper. This copy is made out of brass.

The way this machine works is that he took siphoned the air out of the middle space between the two hemispheres. To do so, you attach the hose here. [Showing with his hands.] You suck the air out of the middle with a vacuum pump. Then Von Goerke demonstrated how powerful the effect of his experiment is. If the air in the middle isn't pushing out, then the air on the outside is pushing in powerfully, and we wouldn't be able to get the two hemispheres apart. He wanted to show how unbelievably strong the connection is, so the way he did it was to create a vacuum pump, and he attached it just like this. [Again showing with his hands.] The original one was made in the late 1600's, a long time ago. You'll see some pictures of the experiment in a few minutes.

So are we ready to go? We close that valve. We turn this one on. [The vacuum pump is attached to the Magdeburg Hemispheres and turned on, sucking the air out from between them.] We wait until the gauge hovers near 30, and then we close this valve, turn it off. We try to take the two hemispheres, called a sphere, apart, and now . . . . Can you pull them apart? I need somebody strong to do this. [Hands to a youth the two Magdeburg Hemispheres joined tightly

together by atmospheric pressure on the sphere.] Go ahead, put some muscle into it. There are no screws or anything holding the sphere together, right? Okay. Why don't you two biggest guys give it a try, one on one side, one on the other. Let 'er rip. [Two larger youths struggle unsuccessfully to separate the two hemispheres.] Oh, come on! Okay. Okay.

Let me show you some pictures now. All right, the first one.



Two Small Hemispheres Defy 16 Draft Horses

Here's why you can't get them apart. How many horses are shown in this picture? – 2, 4, 6, 8, 10, 12, 14, 16 horses pulling on one of those spheres, right there in the middle. And they can't get it apart. You guys didn't stand a chance. That's a picture of the original experiment, in which Von Gericke had 16 horses, eight on each side, pulling against the hemispheres, and he still couldn't get them apart, simply because of the power of air pressure.

A Monument Celebrates the Failure of Horsepower

There's a big monument in the town square of the village of Magdeburg, commemorating the town's historic experiment. On the next page is another picture of the same monument being photo-bombed by a tourist.

The Monument Is Photo-Bombed by a Tourist

Here are some professional football players trying to pull the hemispheres apart.

Pro Footballers too Weak for the Job

Do you see it coming apart? Are they strong guys?

The following picture is of the original equipment.

Here Are the Original Vacuum Pump and Hemispheres

In the 1600's Von Gericke had the two hemispheres made out of copper and had the surfaces machined very nicely. Here, I'm going to take this sphere apart. All I have to do is open the valve. [Opens valve and separates the sphere into two distinct hemispheres.] The surfaces of the two hemispheres are made extremely flat, machined in a very precise way so that air can't leak in around the edges. The picture above shows Von Gericke's vacuum pump, made in the 1600's, which is like the original version of a bicycle pump that he used to create the vacuum.

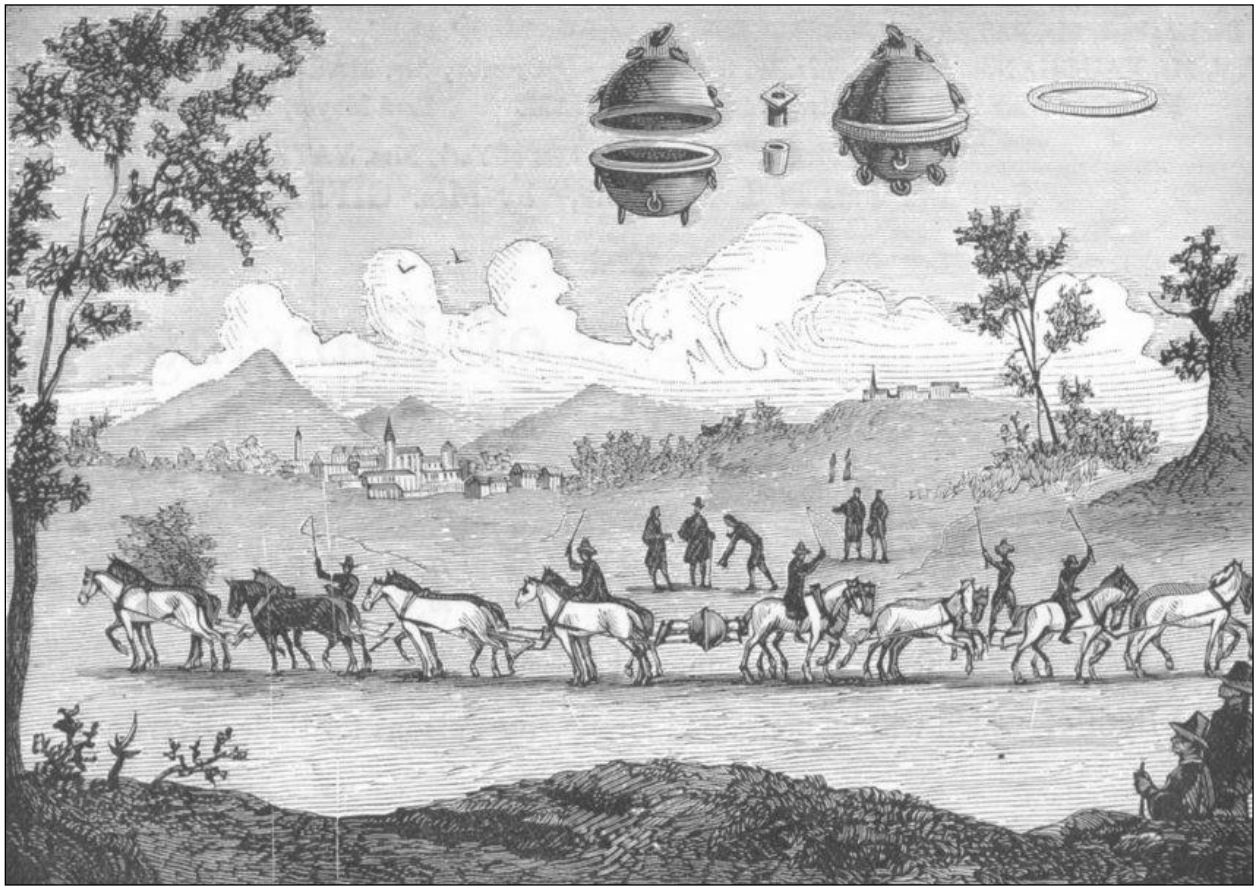
On the following page is a picture of Otto von Gericke, mayor of Magdeburg.

Otto von Gericke, Mayor of Magdeburg

The next picture presents a couple of idiots, just to show what happens in physics classes all across the country.

A Couple of Idiots Play at Physics Physiques

Finally there's another one of those pictures of the original experiment. You guys had no chance.



The Experiment Revisited

Here's the lesson. Let's do this experiment one more time. Would you hold it? Both hands. I put the hose on like that, and we close this. Are you ready? [Turns on the vacuum pump.] Now we close the valve and turn the pump off. [Turns off the pump.] We can now maintain pressure in the bell jar, and take the hose off. [Removes the hose from the bell jar, and it maintains pressure.] Now, can you pull it apart? No? Don't let anybody make fun of you, because they can't do it either.

Air Is Like the Spirit:
Around Us, Within Us, and Giver of Life

The lesson is that human beings, if they turn the valve, can do virtually anything. This is something you can learn in science class, and you undoubtedly will as you go into high school and take science classes. But there's another lesson I want to teach you. And that is people find it strange that creating a vacuum inside this sphere is strong enough that a person really, seriously can't get it apart, no matter how hard one tries. Even if you use football players or horses.

People make the same mistake when they think about the power of the spirit. You as children tend to think at your age that your body is who you are. So here I am. This is my body; this is who I am. But it's not really who we are as people. Who we are as people is our spirit that lives within our body. That spirit is unbelievably powerful.

So Jesus, when he walked on water, did it by the power of spirit. When he turned water into wine, he did it by the power of spirit. When he had people who were desperately ill and he cured them, he did it by the power of his spirit. He said that, quite literally, if we wanted to tell a mountain to go from here to over there, then through the power of our spirit, which is made in the image and likeness of God, we have the means to do that. All of those things, amazing things that Jesus did, that we've read about, he said we will have the ability to do that and more.

But only when we cultivate the power of our own spirit. Air is like the spirit. It's all around us, but it's also within us, and it gives us life.

And so on this Sunday, when we're concluding Sunday school for the year and you're about to enter your summer activities, think about the spirit. Think about the air that you breathe, the wind that is all about us, but it's the spirit that keeps us alive and actually makes us very powerful.

I hope you had a good year at Sunday School. Thank you.

Amen.