What is a Barometer?

Standard II:

Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.

Objective 3:

Evaluate weather predictions based upon observational data.

Intended Learning Outcomes:

1- Use Science Process and Thinking Skills
3- Understand Science Concepts and Principles

Content Connections:

Language Arts, Writing

Science Standard II

Objective 3

Connections

Background Information

As previously mentioned, Earth's air has pressure because of the air molecules stacked on top of each other from Earth's surface to the edge of space which is about 70 vertical miles. This pressure is greatest at Earth's surface, and gradually this pressure lessens as the air goes vertical toward space. However, as previously mentioned, the air pressure can change at and near Earth's surface. It changes because of more pressure put on these air molecules or less pressure on these air molecules. It is this pressure change at and near Earth's surface that brings us our different weather. It has an effect on the temperature, the movement of the air (wind), the types of clouds that will form, and the type of precipitation. And most of all, the changing air pressure is what makes the water cycle continue to go on and on and on.

There is an instrument that we use to measure the air pressure and it is called a barometer. There are numbers on a barometer that range from 28 to 31. *One misconception that many people have about the barometer is that a barometer measures temperature because of these numbers.* But these numbers measure the air pressure. (The story in Activity One will tell you why we use these numbers.) *Another misconception about the barometer is that people believe that the barometer tells us what the weather is right now. The most fascinating thing about the barometer is that the barometer tells us what that weather is going to be in one or two days. It is a device for predicting the weather.*

Generally, if the needle on a barometer is above 30, our area is going to have nice weather for at least one to two days. The higher the needle is above 30 the nicer the weather will be. Generally, if the needle of a barometer drops below 30 there is going to be change in the weather. The temperature is going to change, clouds will be moving in, there is going to be a change in the air movement (wind),

and we could get some precipitation. The lower the needle moves below 30, the more drastic these changes will be in a couple of days. Generally, if the barometer is at 30 this means we could lose our very nice fair weather to some wind, partly clouded skies, and a slight temperature change, but usually with no storms on the horizon. The 30 means that a storm is nearby, but it isn't going to reach us.

Research Basis

Neufeld, P., (2006). Comprehension instruction in content area classes. *Reading Teacher*, Vol. 59 (Number 4), Page 302

For students to be able to successfully comprehend the texts of social studies and science, teachers need to be teaching comprehension strategies and not leave them alone in finding their own devises. Ideas to consider in comprehension in content reading are:

- What is the purpose of this reading?
- How is the text organized?
- What are the key words?
- What are the important points?
- What type of graphic organizer can be used?
- What assessments can be used for understanding?

Fisher, D., Ivey, G., (2005). Literacy and language as learning in content-area classes: a departure from "every teacher a teacher of reading". ***Action in Teacher Education***, Vol. 27 (Number 2), Page 2

All learning is language based. Including reading and writing regularly as ways for students to gain new information is important. Before, during, and after a prescribed activity, reading, writing, listening, viewing, and discussion should play a larger role than lecture. In the content areas creating the reading and writing experiences should focus on the big ideas.

Invitation to Learn

Materials

- ❑ Weather map(s) from the newspaper
- ❑ Aneroid barometer

The Highs and Lows of Weather

Pass out to the students a weather map from the newspaper that has many highs (H) and lows (L) on it. They can each have his/her own copy of different days or make a copy so each student gets the same one.

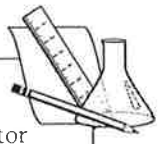
1. Ask, "Do you know what this paper is?" (It is a weather map from the newspaper.)
1. Ask, "Why is this in the newspaper each day?" (It tells us what the weather is going to be for that day.)

2. Ask, "How do weather forecasters (meteorologists) know what the weather is going to be?" (They have weather instruments that help them predict the upcoming weather.)
3. Ask, "What do the capital H's and L's mean on a weather map. (They may not know the answer to this, so you may have to tell them. The H's mean that those places have a high pressure over them and they are going to have nice weather for the next couple of days. The L's mean that those places have a low pressure over them and they have going to have stormy weather for the next couple of days.)
4. Ask, "What other symbols do you see around the L's?" (Rain and/or snow.)
5. Ask, "Do you see other symbols around the H's? (Yes, if there is a sun; no if there is nothing there.) This means they will have a lot of sunshine today.
6. Show the students a barometer. Tell them that this is one of the instruments meteorologists use to predict the weather. This is called an aneroid barometer. This instrument measures the air pressure and shows air pressure changes. It tells us if the air pressure is high (H) or if the air pressure is low (L). But there is something special about a barometer. This instrument tells us what the weather is going to be like in one or two days not what the weather is like today. Today we are going to learn about the barometer and how it helps us predict the weather.

Instructional Procedures

The Discovery of the Barometer (a teacher demonstration)

1. Put on a white lab coat, if possible, so you look like a scientist.
2. Set up a similar situation that Torricelli had when he discovered the mercury barometer.
   - Bowl with colored water in it.
   - Two hollow balloon holders taped together with a 29" mark on it, a 30" mark on it, and a 31" mark on it.
3. Pass out the shared reading of *Torricelli and the First Barometer* (if desired).



Materials

- ❑ Overhead projector
- ❑ Overheads of the presentation of the "Discovery of the Barometer"
- ❑ Shared reading about the barometer discovery
- ❑ Hollow balloon holders
- ❑ Small bowl
- ❑ Food coloring (any color)
- ❑ Water
- ❑ Lab coat (optional)

4. As you read the story put up the different overheads so the students have a visual idea of what is happening in the reading.

The Story of the First Barometer

Around the time of 1643, there was a young scientist/ mathematician by the name of Evangelisti Torricelli who was very interested in air pressure. (Put on the picture of Torricelli.) Scientists at the time knew that air pressure existed and they knew that it changed. They had an idea that when there was an air pressure change there was going to be stormy weather. But, they had no way of measuring the air pressure like they could measure temperature with a thermometer. Torricelli was very interested in finding a way to measure air pressure so he could see air pressure changes.

One day Torricelli got a three-foot glass tube that was closed in at one end and open at the other. (Show the picture of Torricelli with the tube in his hand.) With a suggestion from his friend, Galileo, he filled the glass tube with mercury. (Show the plastic tube.) Mercury is a liquid metal that is much heavier than water. He also had a bowl of liquid mercury. (Show the bowl of colored water.) After filling the glass tube with mercury, he tipped the tube upside down, holding the open end with his finger so the mercury wouldn't run out. (Demonstrate this with the plastic tube.) With his finger on the end he gently put the open end of the tube in the bowl of mercury. He then took his finger off the glass tube. (Put the tube into the water and take your finger off.) At his surprise the mercury dropped about 6 inches to the 30-inch mark. (Point to the 30-inch mark on the tube.) He marked this point as a reference point so he could notice any changes in the level of the mercury inside the tube.

He set his mercury instrument up in a safe place in his laboratory and observed it many times a day. He put marking on the tube so he could see if the mercury level moved inside the tube. (Put on the picture of the two mercury tubes showing the two dates of the low and high mercury markings.) On October eighth he noticed that the mercury dropped below the 30-inch mark. (Point to the mark below the 30-inch mark on the plastic tube.) Then a day later he observed that weather had changed and became stormy. On October eleventh he noticed that the mercury jumped above 30-inch mark. (Point to the mark above the 30-inch mark on the plastic tube.) He observed that the weather was fair a day or two later. (Show the picture of the arrows pressing on the bowl of mercury.) He kept track of the changes of the level of the mercury in the tube.

Torricelli concluded that whenever the level of the mercury was below the 30-inch mark a storm was coming. And, the farther the

mercury level was below the 30-inch mark the worse the storm. This is why we use the word "Low" because the mercury was lower than 30 inches in the tube. (Refer they weather map they looked at in the Invitation to Learn.) He also concluded that whenever the level of the mercury was above the 30-inch mark, fair weather was in its way. And, the farther the mercury level was above the 30-inch mark the better the weather was going to be. This is why we use the word "High" because the mercury was higher than 30 inches in the tube. (Refer they weather map they looked at in the Invitation to Learn.) (Show the picture of a mercury barometer today.) Meteorologists still use the mercury barometer today, because it is the most accurate instrument to use to measure air pressure change.

5. (Show the real aneroid barometer.) Tell them that this barometer does not have mercury inside because we have found out that mercury is very dangerous for everyday use.
6. (Show up the picture of the aneroid barometer.) This barometer has a needle that goes back and forth from the 29 to the 31 by the use of gears inside the barometer. (Point to the needle.)
7. (Put up the picture of the inside of the aneroid barometer.) These gears are attached to a very small "can" that has no air in it. Aneroid means "containing no air."
8. (Put up picture of the aneroid can.) As a high pressure enters an area, the high pressure will push in on the "aneroid can" (because of the vacuum inside) that in turn moves the gears. These gears move the needle up above the 30-inch mark telling us that we have high pressure around us.
9. As a low pressure enters an area, the low pressure will release pressure on the can making the can not bent in as much. The gears will move the needle below the 30-inch mark telling us that we have low pressure around us.
10. (Show the picture of the barometer on the wall.) We can hang aneroid barometers on our walls at home and watch to see if a storm is coming or if we are going to have nice weather.
11. Put an aneroid barometer in a see-though bowl. Cut off the neck of a balloon and stretch it over the bowl. Push in on the balloon.
12. Ask, "What do you see happening to the barometer?" (The needle went up showing a high pressure.) Ask, "Why do you think it went up when you pressed on the balloon?" (The

air particles packed together in a smaller area creating a high pressure.)

13. Pull up on the balloon. Ask, "What do you see happening to the barometer?" (The needle went down showing a low pressure.) Ask, "Why do you think it went down when you pulled on the balloon?" (The air particles are spread out in a larger area creating a low pressure.)
14. In conclusion, describe that:
    - When high pressure enters the atmosphere, it presses on the "small can" and the barometer goes up.
    - When low pressure enters the atmosphere, it presses on the "small can" and the barometer goes down.
    - The changes in air pressure are what cause our different weather.

Assessment Suggestions

1. As the teacher is asking the questions, the students can be writing in their science journals the answers to the questions. Check their journals for accuracy during the discussion.
2. Use a Cluster Diagram to outline the three types of pressure the barometer measures for us and the results of each of the readings.
2. Have the students draw pictures of the experiments and label the parts. Have them write captions under the pictures of what happened in the experiments.
3. Divide the class into groups of three or four students and ask them to discuss and answer these questions in their journals or on paper.
    a. What happens to the air molecules near Earth's surface when a high pressure is approaching?
    b. What happens to the air molecules near Earth's surface when a low pressure is approaching?
    c. Why did the mercury go up in Torricelli's mercury barometer when there was a high pressure present?
    d. Why did the mercury go down in Torricelli's mercury barometer when there was a low pressure present?
    e. Explain how an aneroid barometer works.

f. Explain why the barometer needle went up when the balloon was pressed on the bowl.

g. Explain why the barometer needle went down when the balloon was pulled on the bowl.

3. Have the students tell how the mercury barometer and the aneroid barometer are the same.
4. Have the students tell how the mercury barometer and the aneroid barometer are different.

Curriculum Extensions/Adaptations/ Integration

- For regular and advanced learners, have them learn more about Torricelli and the discovery of the mercury barometer.
- For learners of special needs, gather them together and show the experiments again giving the simple explanations of what is happening and asking simple questions to answer.
- Have the students draw a picture of what the air molecules look like inside in the glass jar at different stages of the experiment including what the air molecules look like outside the glass jars. (Visual Arts: Standard III, Objective 2)

Family Connections

1. Send home the story about Torricelli's experiment in discovering the mercury barometer. Have them discuss how this knowledge has helped us to cope with the weather.
2. Send home a picture of an aneroid barometer. Have the students tell how this barometer works.
3. Have the students go to an Internet site to read more about the barometer and share with their families what else they learned about the barometer.

Additional Resources

Books

Wind and Air Pressure, by Alan Rodgers and Angella Streleck, ISBN 1403401306

Videos

Forecasting and Weather Instruments VH 2001 United Learning

Weather station: Backyard Science VH 1996 BFA/Phoenix

Weather: Changes and Measurement VH 1999 Educational Videos

Web sites

http://inventors.about.com/od/tstartinventors/a/Barometer.htm

http://www.infoplease.com/ce6/people/A0849103.html

http://www.tiscali.co.uk/reference/encyclopaedia/hutchinson/m0013248.html

Name _____

What Is It About Air Pressure?

I. Gather together in groups of three, four, or five. Discuss these questions as a group. Write down the answers with help of the discussion.

1. What happens to the air molecules near Earth's surface when a high pressure is approaching?

_____

_____

2. What happens to the air molecules near Earth's surface when a low pressure is approaching?

_____

_____

3. Why did the mercury go up in Torricelli's mercury barometer when there was a high pressure present?

_____

_____

4. Why did the mercury go down in Torricelli's mercury barometer when there was a low pressure present?

_____

_____

5. Explain how an aneroid barometer works.

_____

_____

6. Explain why the barometer needle went up on the barometer when the balloon was pressed on the bowl.

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_____

7. Explain why the barometer needle went down when the balloon was pulled.

_____

_____

8. Thinking question: If you were to take a barometer with you as you were hiking up a mountainside, what do you think would happen to the reading of barometer?

_____

_____

II. Draw two pictures of the barometer in the glass bowl—one at high pressure and one at a low pressure. Have the students draw what the air molecules look like inside in the glass jar when the balloon is being pressed on. Have the students draw what the air molecules look like when the balloon is being pulled on. Label the different parts and show with arrows where the air pressure is. Write captions under each picture of what is happening in the experiment.

Evangelisti Torricelli and The Story of the First Barometer

Around the time of 1643, there was a young scientist/ mathematician by the name of Evangelisti Torricelli who was very interested in air pressure. Scientists at the time knew that air pressure existed and they knew that it changed. They had an idea that when there was an air pressure change there was going to be stormy weather. But, they had no way of measuring the air pressure like they could measure temperature with a thermometer. Torricelli was very interested in finding a way to measure air pressure so he could see air pressure changes.

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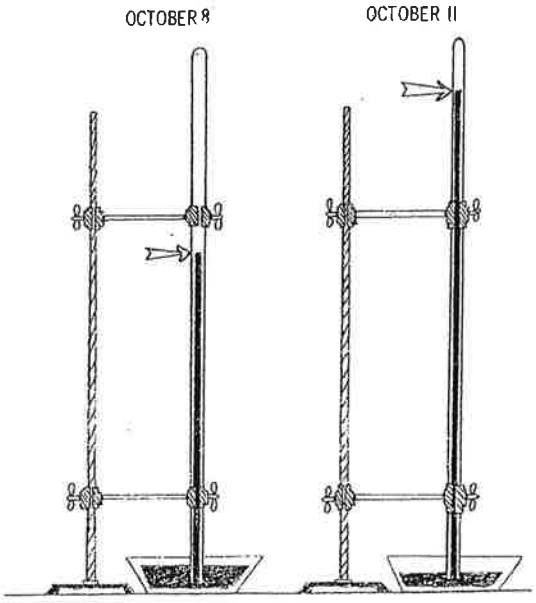

THE HEIGHT OF THE MERCURY CAN VARY FROM DAY TO DAY

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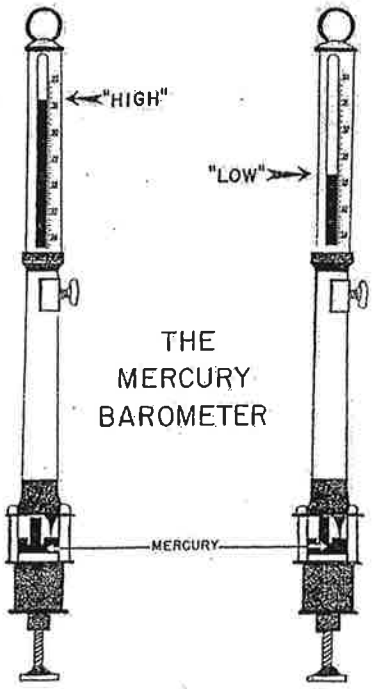

farther the mercury level was above the 30-inch mark the better the weather was going to be. This is why we use the word "High" because the mercury was higher than 30 inches in the tube.

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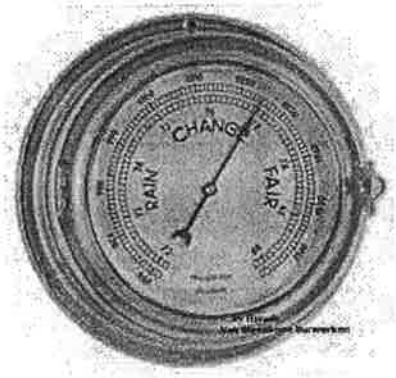
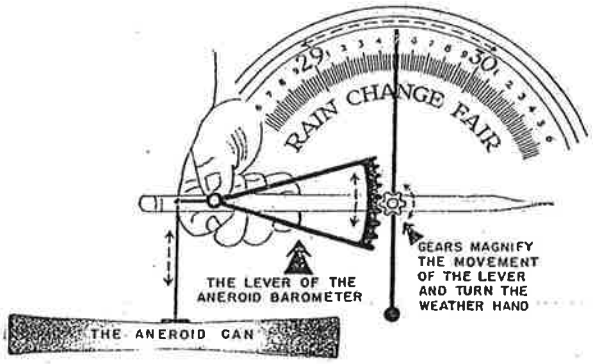
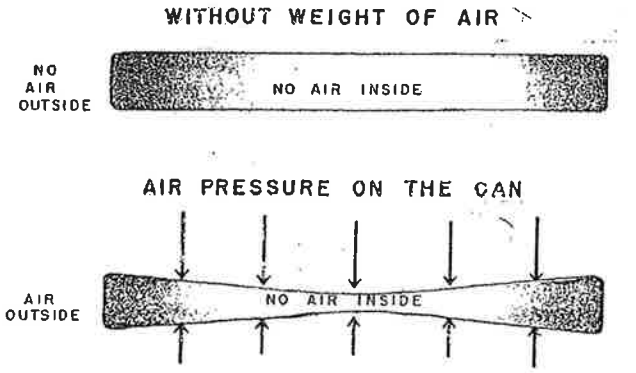
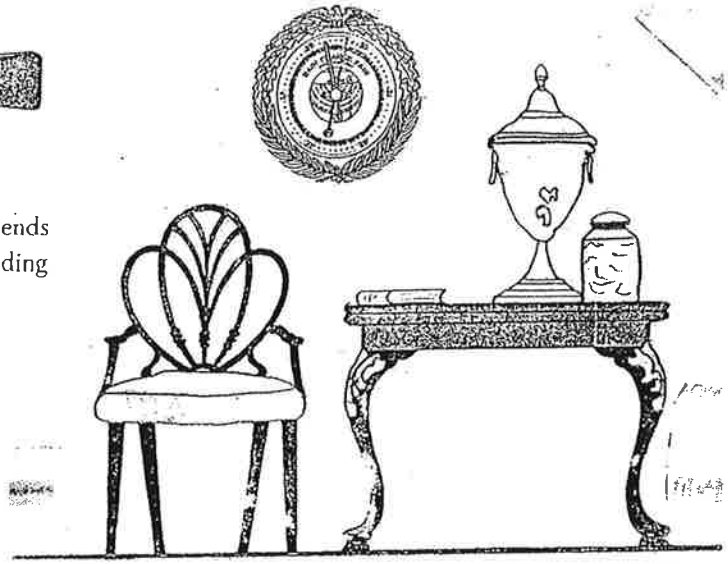




When the air pressure changes, the can top bends or straightens only a little bit; then the hand moves far enough for you to see the change.

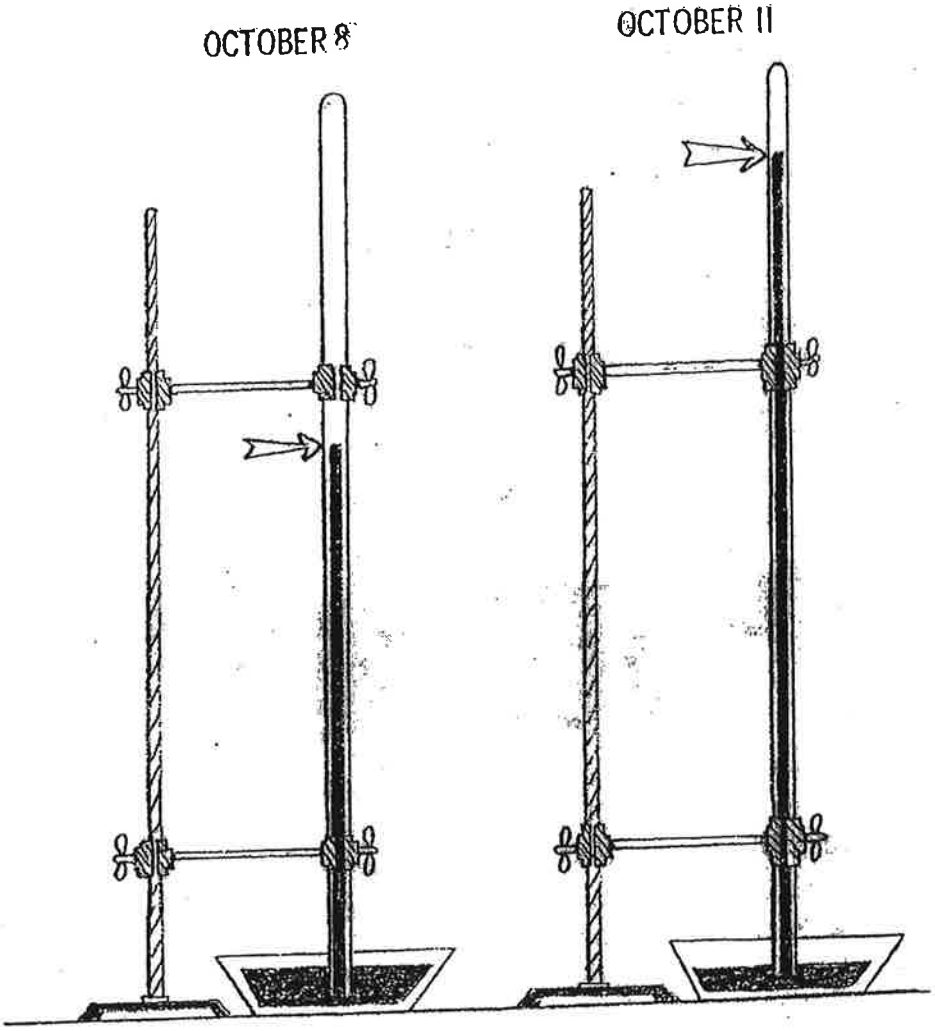


Air pushes against the empty can and bends it in. As the air pressure changes, the bending changes too.



ANEROID BAROMETERS ARE MORE COMPLICATED THAN MERCURY BAROMETERS, BUT THEY ARE HANDY TO HANG ON THE WALL. THEY CAN BE MOVED EASILY BECAUSE THERE IS NO MERCURY TO SPILL. AND THEY ARE CHEAPER.

EVANGELISTI TORRICELLI



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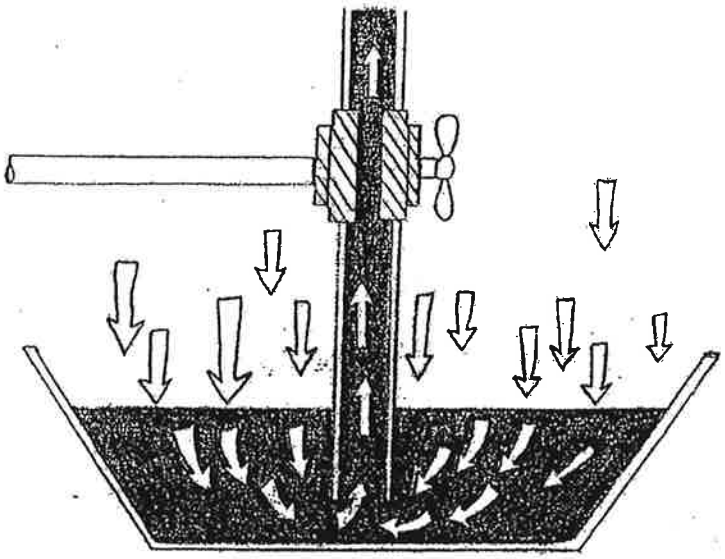
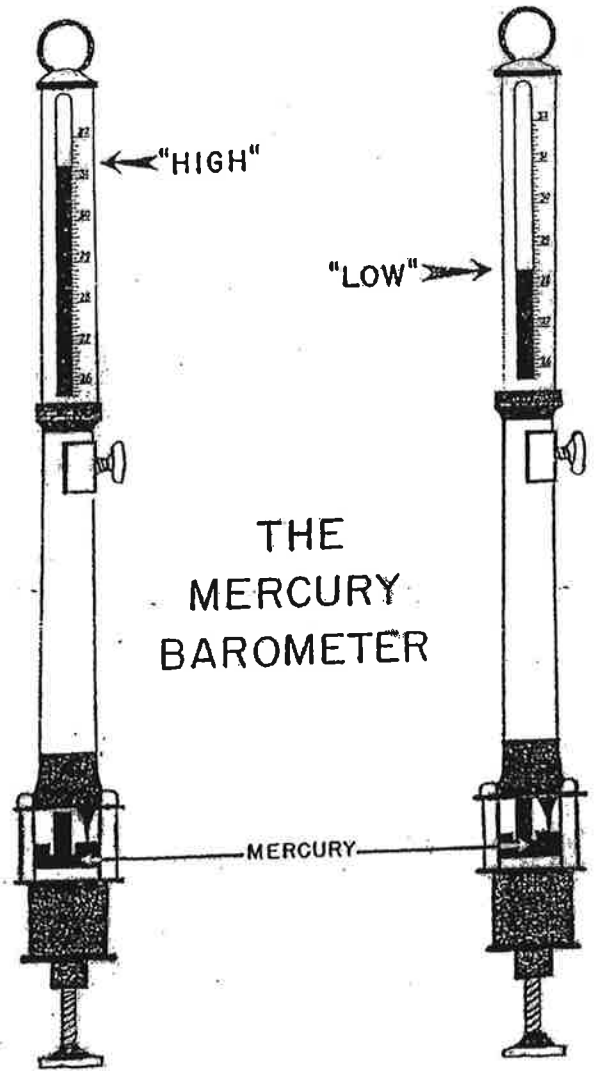
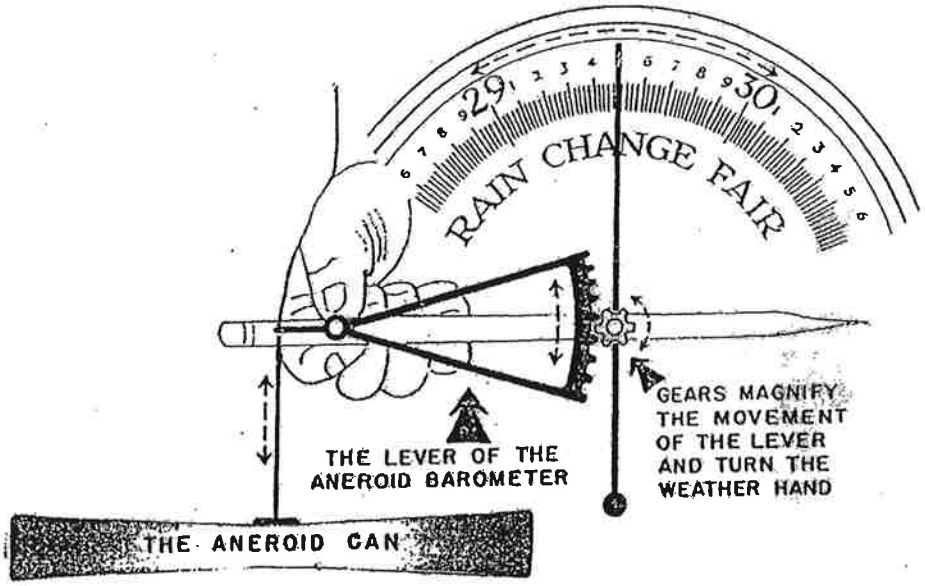


HEAVY AIR, PUSHING HARD ON THE MERCURY IN THE BOWL, SHOVED IT FAR UP IN THE TUBE. WHEN THE AIR WAS LIGHT, IT DIDN'T PUSH SO HARD AND SOME OF THE MERCURY RAN FROM THE TUBE DOWN INTO THE BOWL.


"HIGH"
"LOW"
THE
MERCURY
BAROMETER
MERCURY



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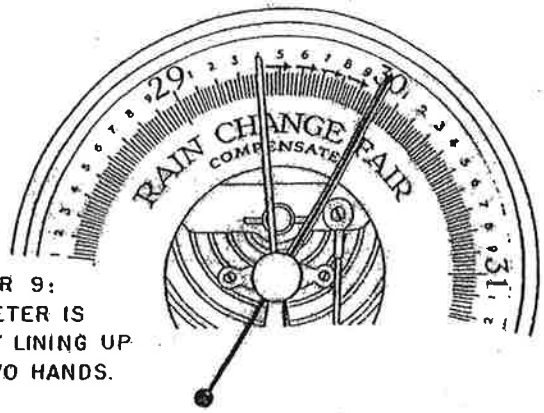
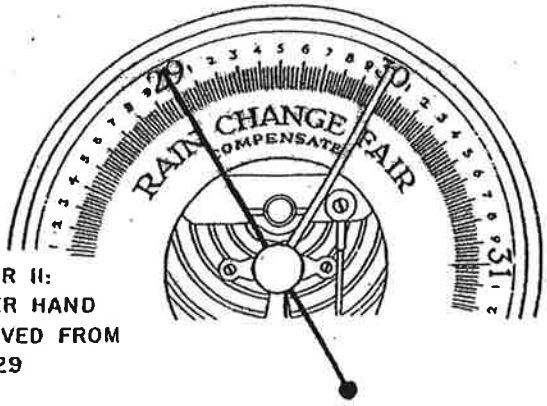


OCTOBER 9:
BAROMETER IS
"SET" BY LINING UP
THE TWO HANDS.



OCTOBER 11:
WEATHER HAND
HAS MOVED FROM
30 TO 29

Cluster Diagram