

Climate Change

WHAT IS IT?
WHERE IS IT GOING?
AND HOW DO WE KNOW?

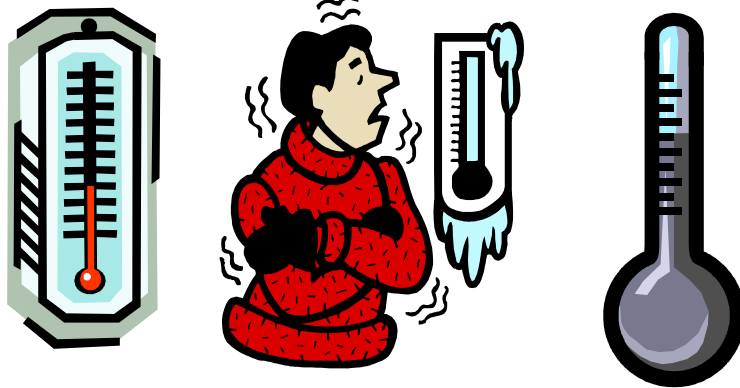
Chapter 2

Increasing
Global Temperature

**TO INVESTIGATE WHAT THE CLIMATE IS DOING,
SEVERAL GROUPS HAVE BEEN CHECKING AVERAGE
GLOBAL TEMPERATURE. IT TAKES WORK.**

- You need to do day and night.
- Also summer and winter
- Tropics, temperate zones
- Etc.
- And you need a lot of weather stations.
Several thousand of them are available for use.
- As of 2007, the global average was between 58°F and 59°F.

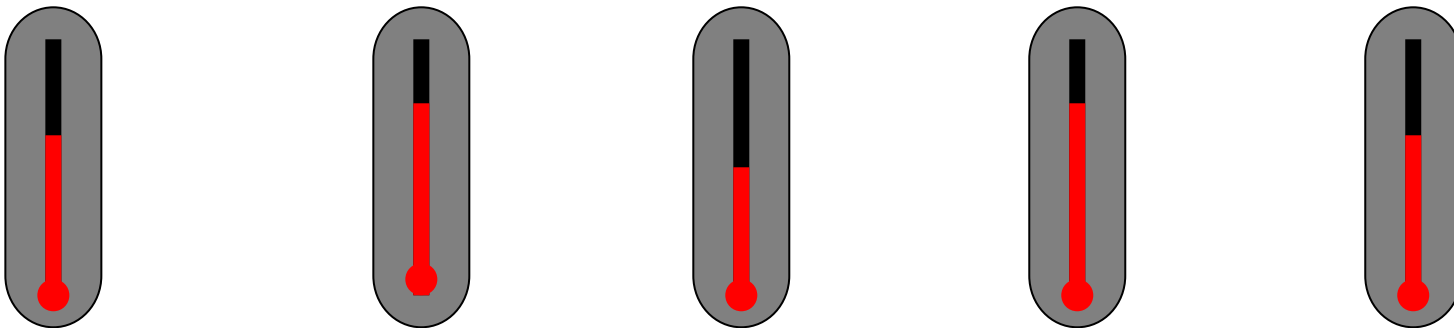
THERE IS A TEMPERATURE RECORD FROM WEATHER STATIONS BACK TO ABOUT 1850. THIS IS THE “INSTRUMENT RECORD”. THE ICE CORES AND SEA BED CORES FROM CHAPTER 1, AS WELL AS OTHER FOSSIL EVIDENCE, CAN BE USED TO EXTEND IT BACK BEFORE THAT. HERE WE WILL HAVE A LOOK AT BOTH OF THESE, THE SECOND OF WHICH HAS CAUSED QUITE A CONTROVERSY.



MANY INSTRUMENTS OF VARYING QUALITY IN DIFFERENT LOCATIONS HAVE BEEN USED. WHAT FOLLOWS IS A BRIEF LOOK AT THE DIFFICULT TASK OF VERIFYING AND CORRELATING THE VARIOUS MEASUREMENTS.

DATA QUALITY CONTROL

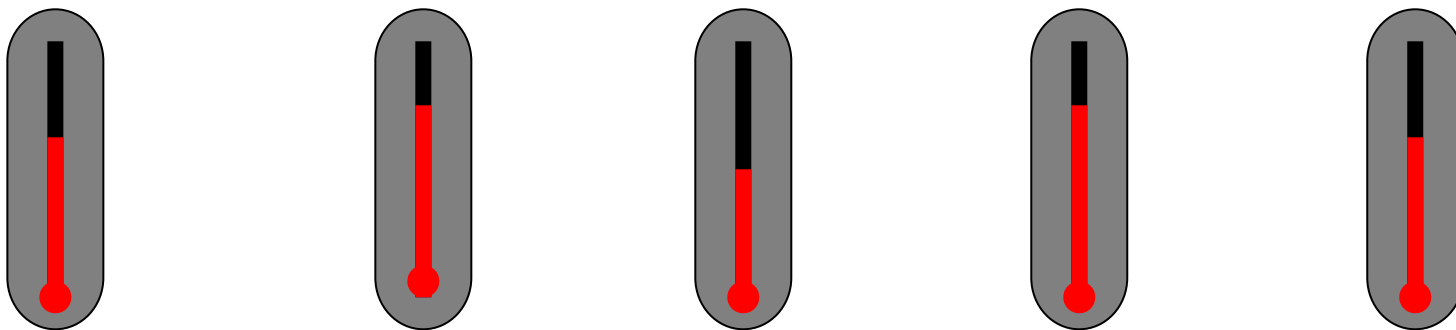
TRY GOING TO A STORE WHERE THEY HAVE A LOT OF THERMOMETERS ON DISPLAY AND CHECKING THE TEMPERATURES ON SEVERAL OF THE THERMOMETERS.



DATA QUALITY CONTROL

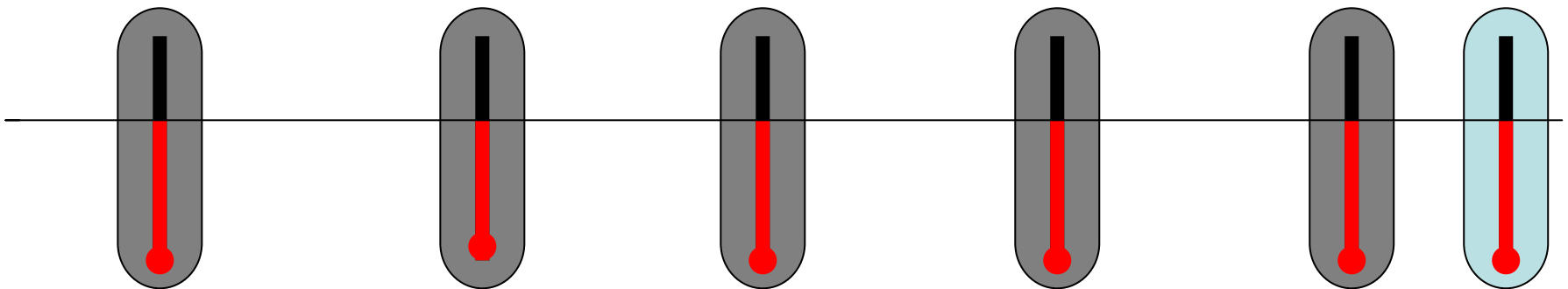
IT IS LIKELY THAT THEY WON'T ALL AGREE,
ALTHOUGH I MAY HAVE EXAGGERATED THE
DIFFERENCES HERE.

THIS IS SOMETHING LIKE WHAT RESEARCHERS
ENCOUNTER WHEN COMPARING THOUSANDS OF
WEATHER STATIONS.



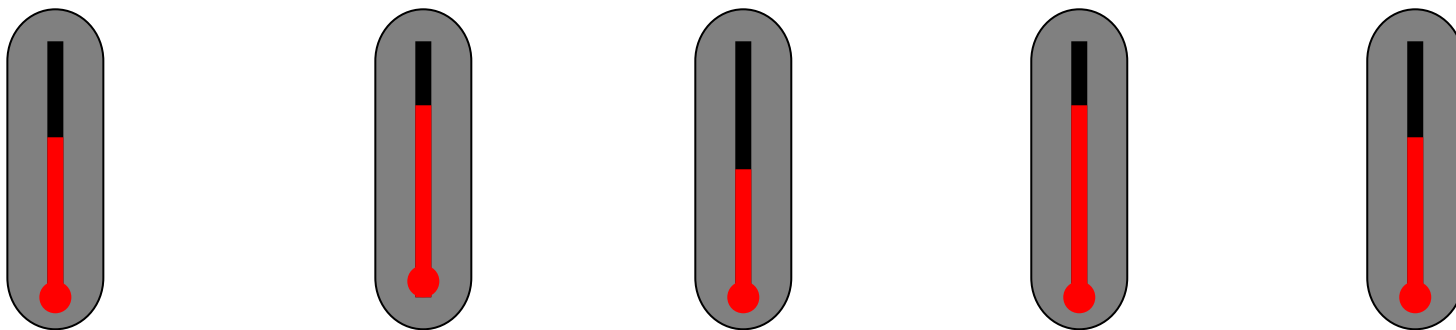
DATA QUALITY CONTROL

RESEARCHERS MIGHT CALIBRATE THEM AGAINST A STANDARD SO THAT THEY ARE ALL MEASURING THE SAME THING. HOWEVER THIS IS A DIFFICULT PROCESS – ESPECIALLY SINCE MANY OF THE MEASUREMENTS WERE ACTUALLY MADE LONG AGO. BESIDES, IF THEY ARE IN DIFFERENT LOCATIONS, THEY MIGHT BE SEEING TEMPERATURES THAT ARE ACTUALLY DIFFERENT.



DATA QUALITY CONTROL

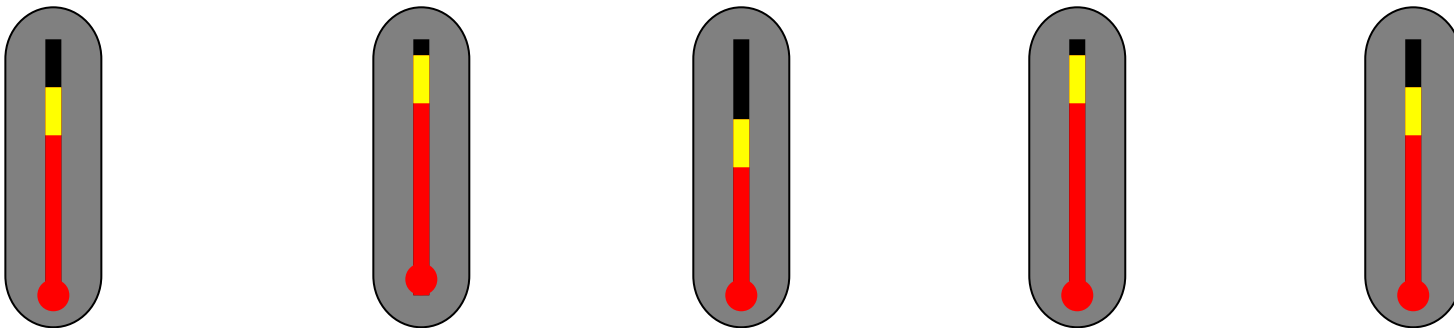
ONE SOLUTION, EVEN IF YOU ARE NOT SURE THAT ALL THE THERMOMETERS ARE OF THE SAME QUALITY IS TO NOTICE THAT THEY ALL GO UP WHEN THE TEMPERATURE INCREASES.



DATA QUALITY CONTROL

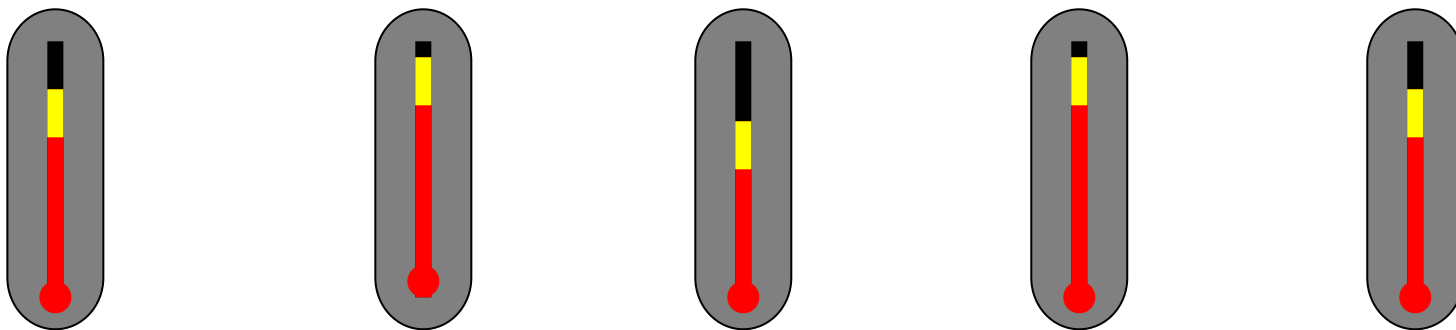
THERE. SEE?

AND THESE TEMPERATURE DIFFERENCES ARE
GENERALLY MORE ACCURATE THAN THE ABSOLUTE
TEMPERATURE.

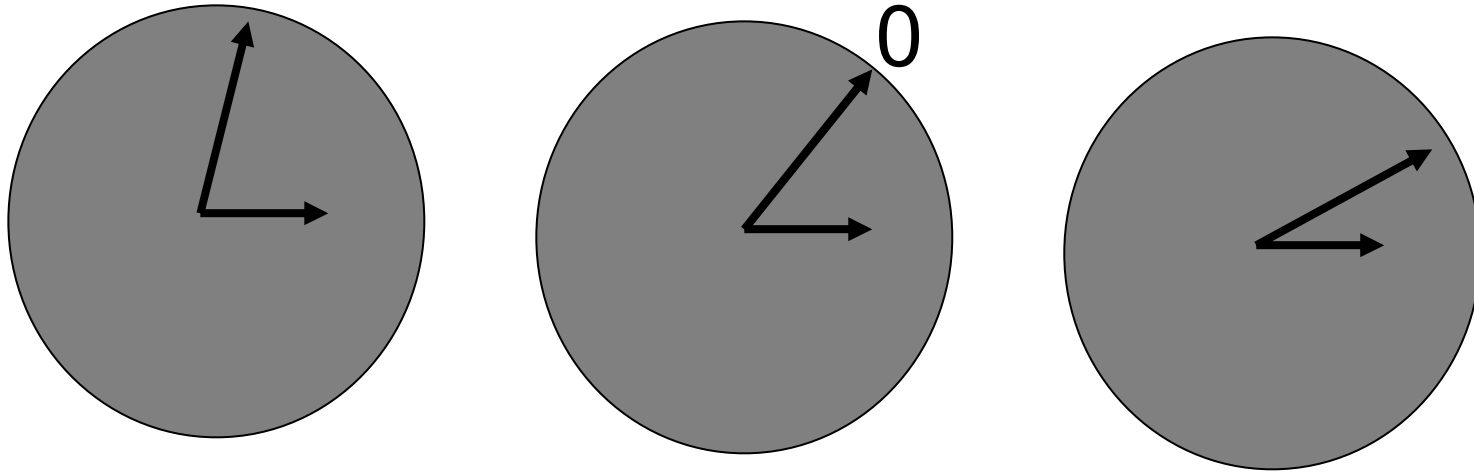


DATA QUALITY CONTROL

SO YOU GENERALLY SEE JUST THE TEMPERATURE DIFFERENCES ON THE GRAPHS THAT RESEARCHERS PRODUCE.



CLOCK QUALITY CONTROL

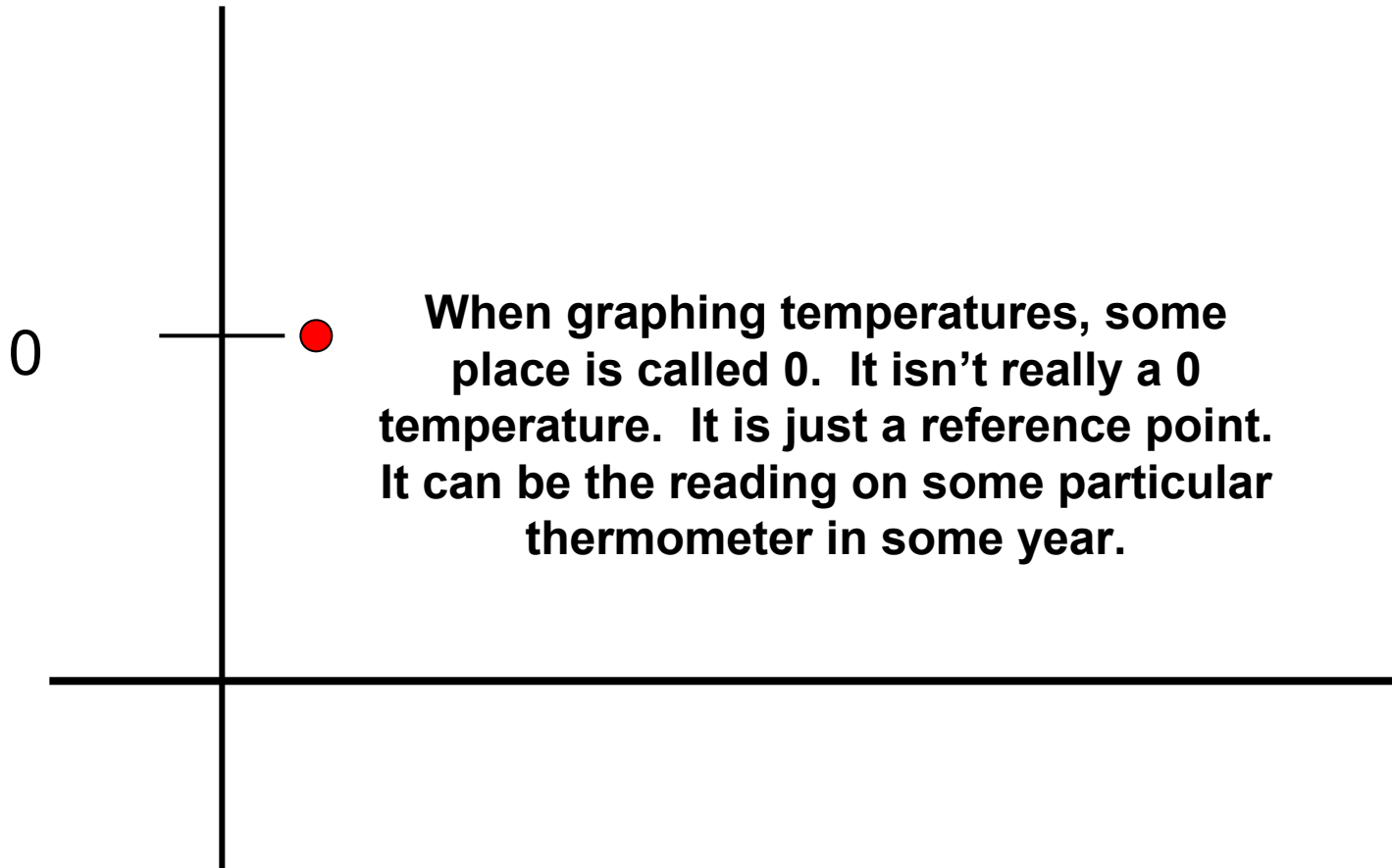


SOMETHING LIKE THAT IS TRUE OF CLOCKS. IF YOU HAD THREE OF THEM, CHANCES ARE THEY WOULD SHOW THREE DIFFERENT TIMES.

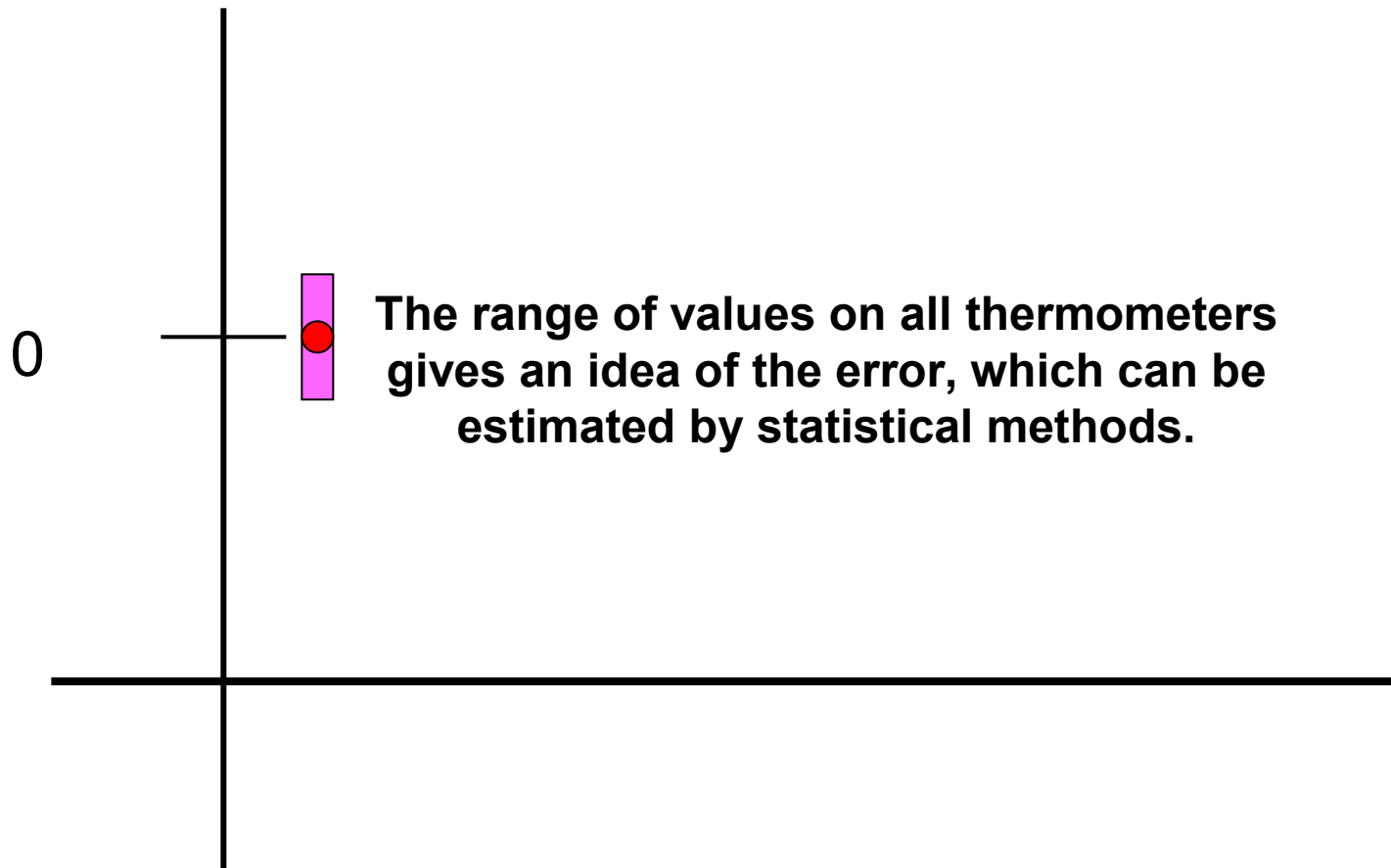
BUT IF YOU NEEDED TO COUNT OFF FIVE MINUTES, YOU COULD DO IT ON ANY OF THEM. JUST MAKE SURE THE STARTING AND ENDING TIMES ARE FIVE MINUTES APART, NO MATTER WHAT THE EXACT STARTING TIME IS.

AND YOU MIGHT AS WELL CALL ONE OF THE STARTING TIMES 0, IF THAT MAKES THINGS EASIER (LIKE WITH A STOPWATCH). LET THE OTHER TIMES BE WHATEVER THEY NEED TO BE TO FIT WITH YOUR ZERO STANDARD.

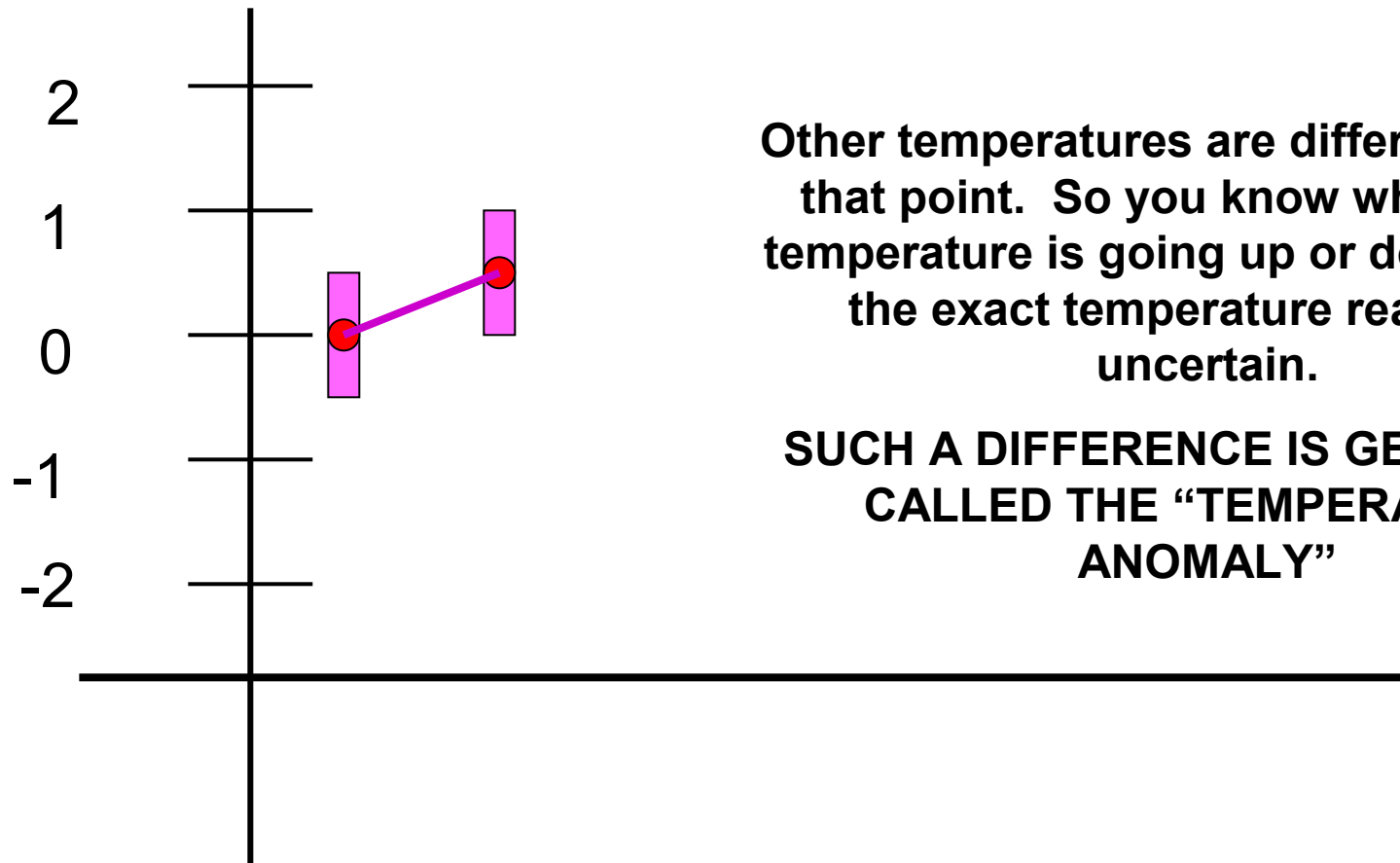
DATA QUALITY CONTROL



DATA QUALITY CONTROL



DATA QUALITY CONTROL

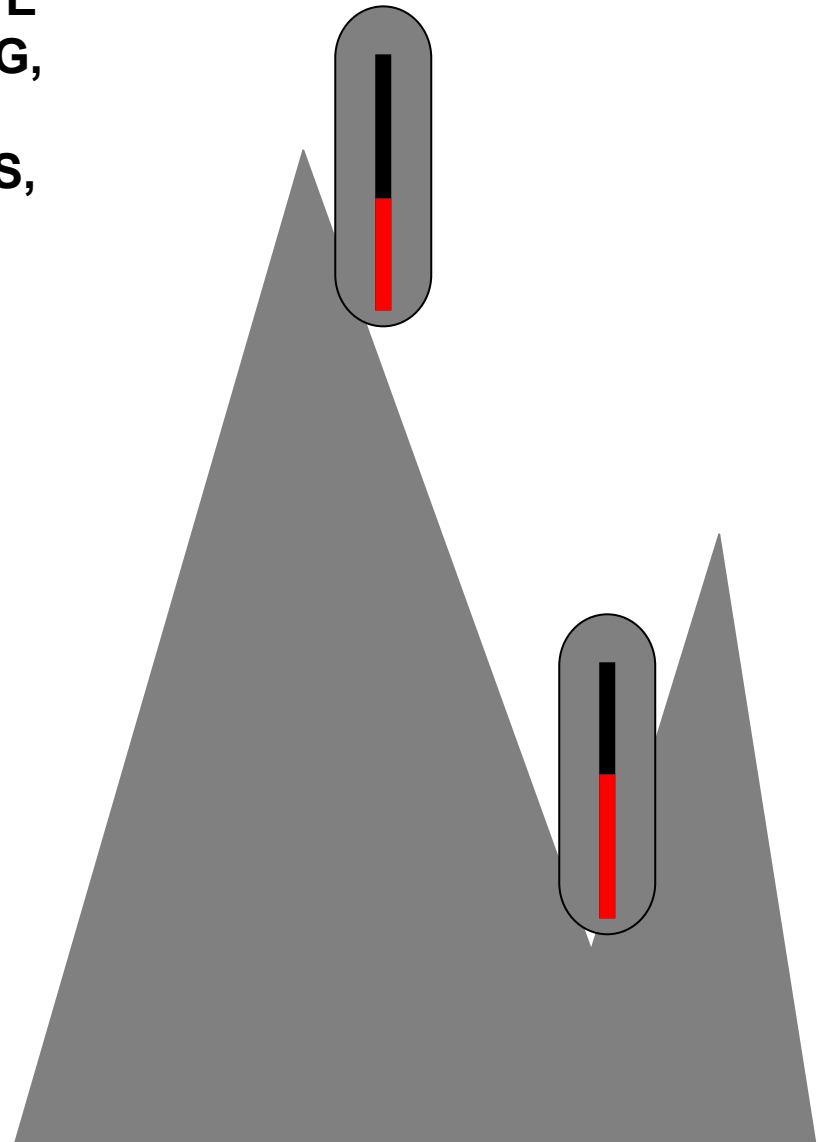
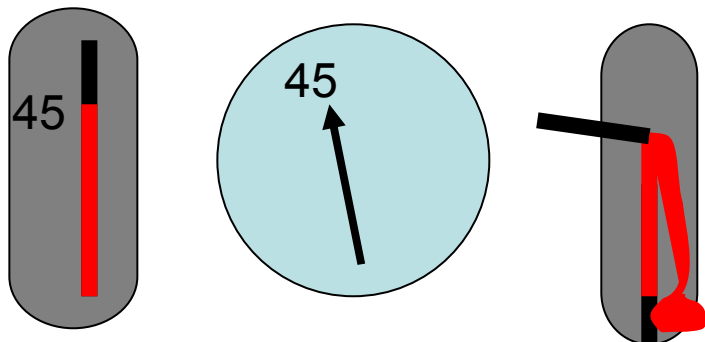


Other temperatures are differences from that point. So you know whether the temperature is going up or down even if the exact temperature reading is uncertain.

SUCH A DIFFERENCE IS GENERALLY CALLED THE "TEMPERATURE ANOMALY"

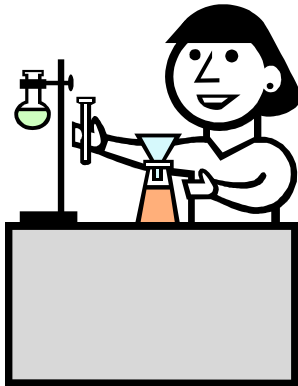
MANY OTHER QUALITY CHECKS HAVE BEEN USED IN THIS WORK INVOLVING, FOR EXAMPLE, CHANGES IN THE ALTITUDE OF SOME THERMOMETERS, TYPE OF THERMOMETER, AND SO FORTH.

THE CHANGES MADE FOR QUALITY CONTROL PURPOSES HERE AND IN OTHER QUALITY CONTROL CHECKS HAVE BEEN VERY SMALL COMPARED WITH THE MEASURED CHANGES IN TEMPERATURE OVER THE YEARS.





JUST MENTIONING ALL THIS IN ORDER TO POINT OUT THAT A LOT OF WORK HAS BEEN DONE TO COMPARE TEMPERATURE INSTRUMENTS AND MEASURING METHODS IN ORDER TO STANDARDIZE THE DATA.



AND THIS WORK HAS BEEN PERFORMED BY SEVERAL DIFFERENT GROUPS WITH CONSISTENT RESULTS. THIS, OF COURSE, GIVES A MUCH GREATER DEGREE OF CONFIDENCE IN THE RESULTS.

For a good, detailed look at the quality checks and other methods of handling the temperature data, look at the following link. It is an example of a scientific paper from 1999 presenting a lot of global temperature data. It is very technical, but you can have a look anyway:

http://pubs.giss.nasa.gov/docs/1999/1999_Hansen_etal.pdf

[PASTE TO YOUR BROWSER, IF NECESSARY. THERE IS A LIST OF WEB ADDRESSES FOR THE LINKS TO THE REFERENCES IN THE LAST FEW SLIDES.]

See also the book *Global Warming, The Complete Briefing*, John Houghton, Cambridge University Press (3rd Ed. In 2004)

**One source of information on the results of this work is the IPCC.
(next slide)**

**Several other research groups publish similar results.
(2nd slide ahead)**

IPCC

The Intergovernmental Panel on Climate Change (IPCC) has been established by WMO¹ and UNEP² to assess information relevant for the understanding of climate change.

Most of the world's governments as well as the UN needed to know, in effect, "Is this climate change thing for real?" So the IPCC has been established to tell them. [Details are here.](#)

It has gathered data from many individual research groups, correlated it, evaluated it, and written several reports describing climate change as it is currently observed.

1 - [WMO](#) = World Meteorological Organization (part of the UN)

2 - [UNEP](#) = United Nations Environment Program

IPCC HOME PAGE: <http://www.ipcc.ch/>

2007 REPORT (4TH ASSESSMENT REPORT):

[Summary for Policymakers](#) [Physical Science Basis](#) [Impacts](#) [Mitigation](#)

2001 REPORT (3RD ASSESSMENT REPORT):

http://www.grida.no/climate/ipcc_tar/wg1/index.htm

SOME INDIVIDUAL RESEARCH GROUPS

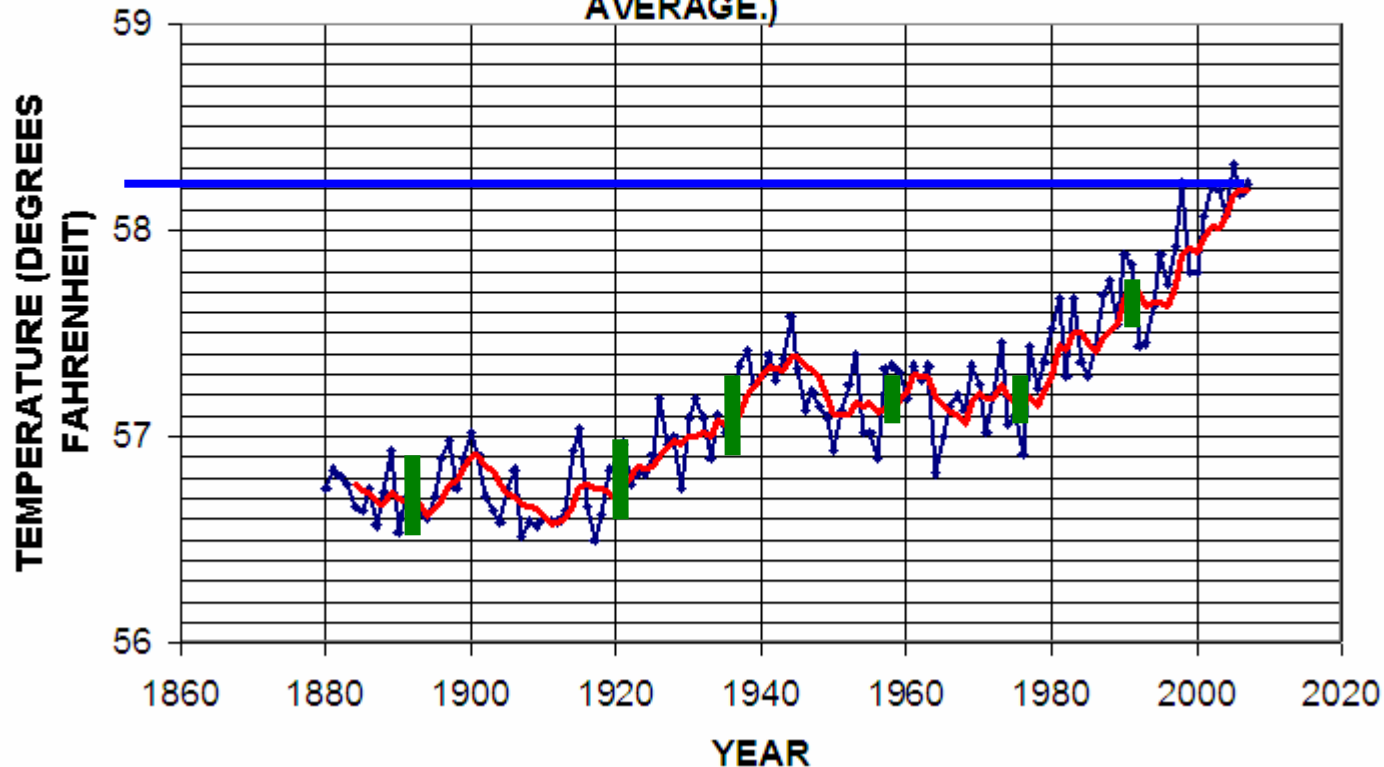
ONE SUCH GROUP THAT HAS BEEN CHECKING GLOBAL TEMPERATURES IS LOCATED AT THE [GODDARD INSTITUTE FOR SPACE STUDIES \(GISS\)](#) IN NEW YORK CITY. HERE ARE LINKS TO [SEVERAL OF ITS CLIMATE GRAPHS](#), AND ITS MAIN [GLOBAL TEMPERATURE](#) RECORD.

ANOTHER IS THE [HADLEY CENTER](#) IN ENGLAND. HERE IS A LISTING OF SEVERAL OF ITS [TEMPERATURE AND OTHER GRAPHS](#) AND ITS MAIN [GLOBAL TEMPERATURE](#) RECORD.

WHAT FOLLOWS IN THE NEXT SEVERAL SLIDES IS THE TEMPERATURE RECORD BASED ON THE GISS DATA.

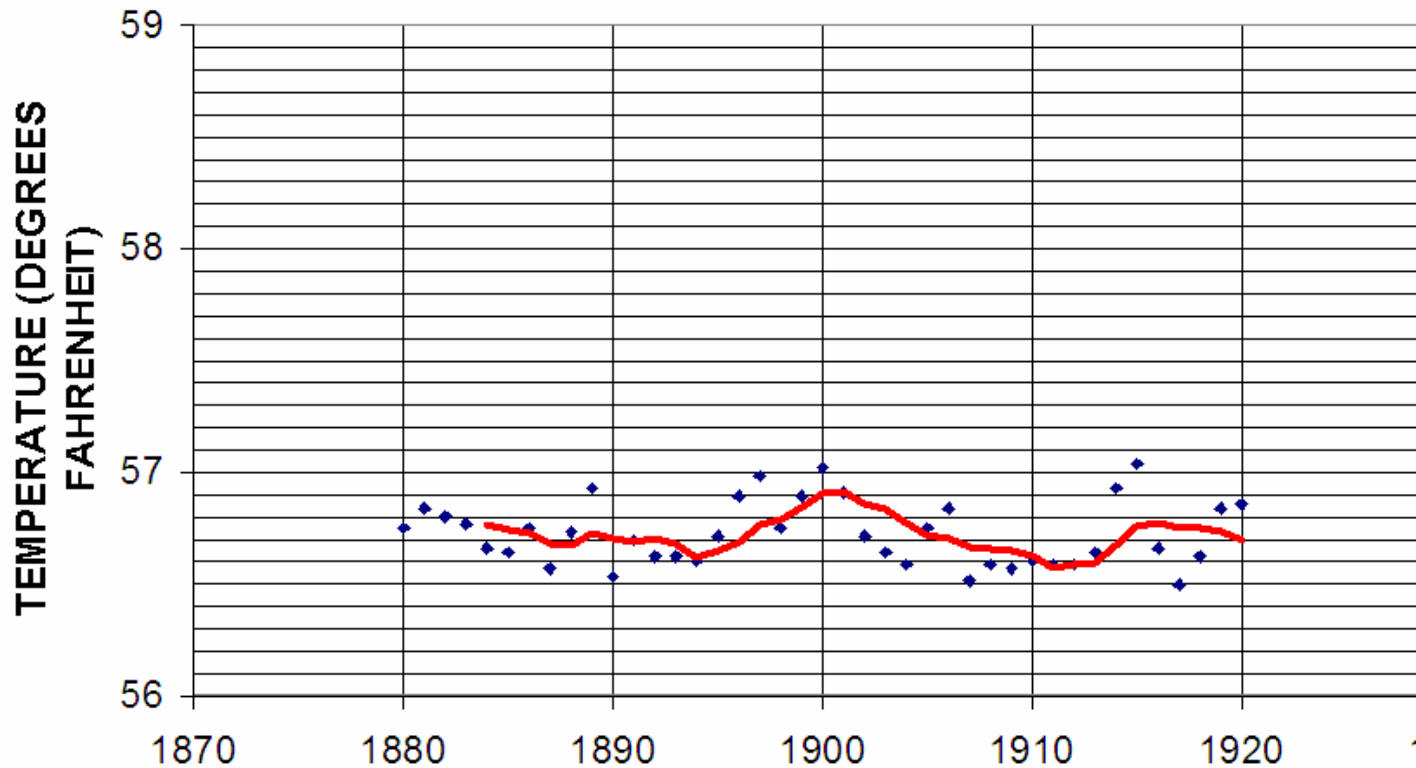
IT IS CONSISTENT WITH THE HADLEY CENTER DATA AS YOU CAN CHECK BY TAKING LINKS TO GISS AND HADLEY.

**AVERAGE WORLD TEMPERATURE
TREND 1880-2007 (DOTS ARE INDIVIDUAL YEARS AND THE DARK
LINE JUST CONNECTS THE DOTS; THE RED LINE IS A 5-YEAR
AVERAGE.)**



I DREW A SERIES OF WORLD AVERAGE TEMPERATURE GRAPHS FROM THE DATA AT THE GODDARD INSTITUTE FOR SPACE STUDIES (GISS). THE GISS DATA IS [HERE](#). YOU CAN SEE MORE INFORMATION FROM THE PEOPLE AT GISS [HERE](#). FOR PEOPLE MORE FAMILIAR WITH FAHRENHEIT TEMPERATURES, I DREW IT THAT WAY, AND I USED ACTUAL TEMPERATURES INSTEAD OF ANAMOLIES (DIFFERENCES) EVEN THOUGH ANAMOLIES ARE MORE ACCURATE. THE GLOBAL AVERAGE IN 2007 IS AROUND 58.2°F, GIVE OR TAKE A LITTLE (BLUE LINE). THE DARK GREEN LINES SHOW ROUGHLY THE ESTIMATED ERRORS CALCULATED BY STATISTICAL MEANS.

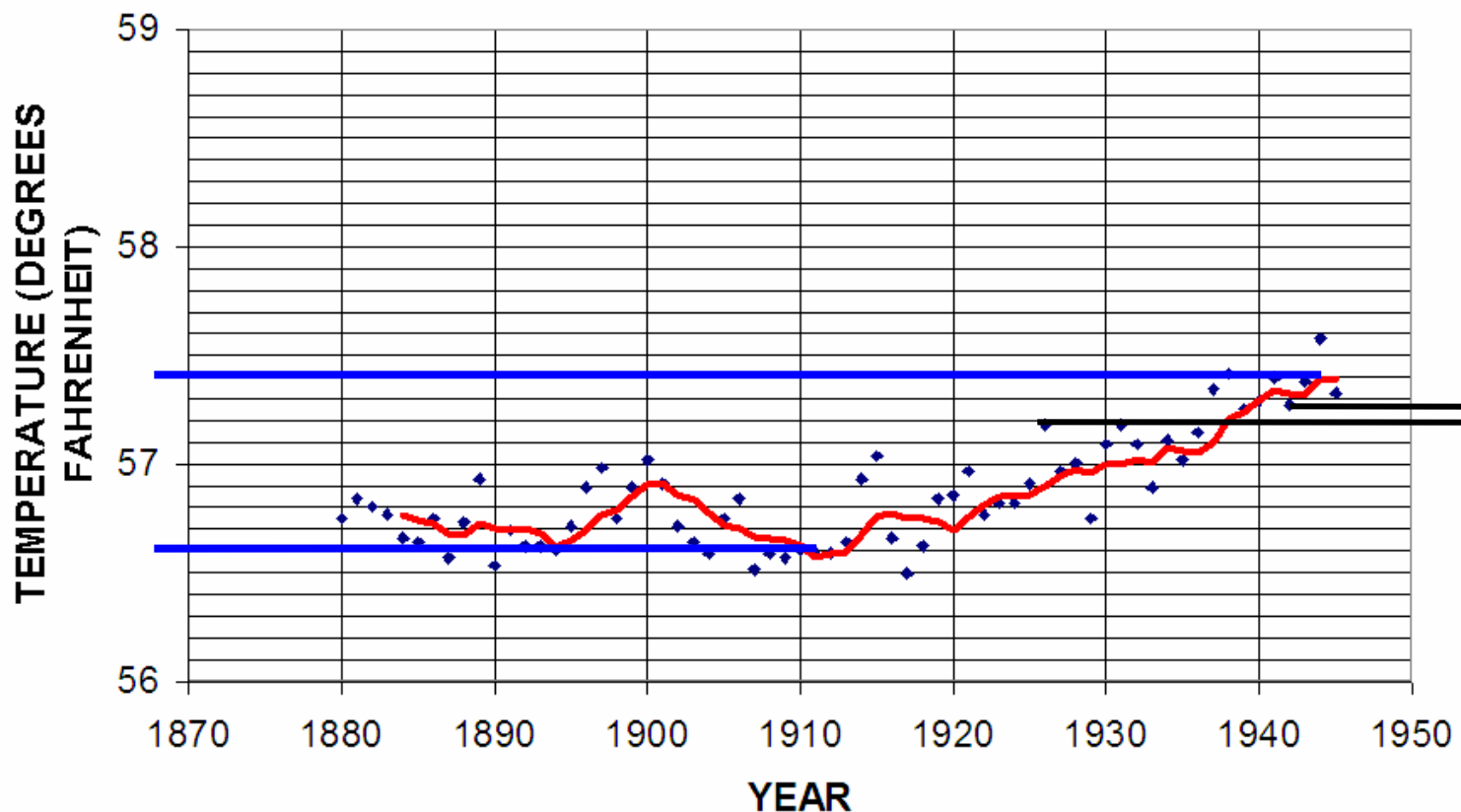
**AVERAGE WORLD TEMPERATURE
TREND 1880-1920 (DOTS ARE INDIVIDUAL YEARS AND RED LINE IS A 5 YEAR
AVERAGE)**



THE POSITION OF THE RED LINE FOR ANY GIVEN YEAR IS THE AVERAGE FOR THAT YEAR AND THE FOUR PREVIOUS YEARS. SO THERE IS NO RED LINE FOR THE FIRST FOUR YEARS. SINCE THERE IS A LOT OF JUMPING AROUND FROM YEAR TO YEAR (SEE THE “CONNECT THE DOTS” LINE ON THE PREVIOUS SLIDE), THIS IS JUST A WAY TO AVERAGE IT OUT, WHICH GIVES A BETTER IDEA OF THE TRENDS.

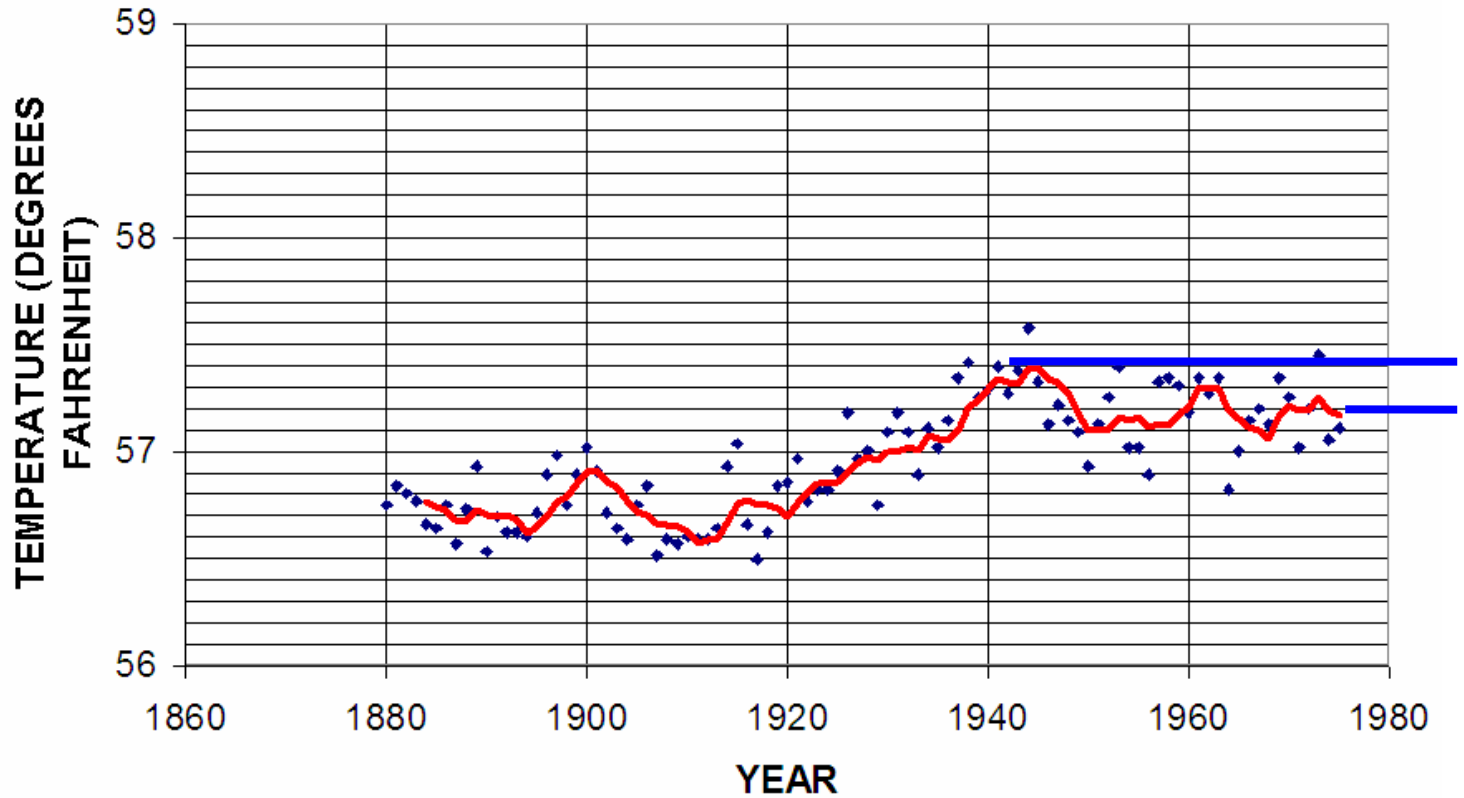
NOTICE THERE WAS NOT MUCH CHANGE IN THE AVERAGE FROM 1880 TO 1920.

**AVERAGE WORLD TEMPERATURE
TREND 1880-1945 (DOTS ARE INDIVIDUAL YEARS AND RED LINE
IS A 5 YEAR AVERAGE)**



WHEN THE GRAPH IS CONTINUED INTO THE 1940'S, A TREND OF INCREASING TEMPERATURE SETS IN. NOTICE THAT THE DOTS FOR THE COOLEST YEARS IN THE 1940'S ARE WARMER THAN THE WARMEST YEARS IN THE 1920'S (BLACK LINES). THE DIFFERENCE IN THE AVERAGE BETWEEN 1912 AND 1945 (BLUE LINES) IS 0.8°F (EACH DIVISION IS 0.1°F.) THAT IS THE SAME AS 0.44°C. A FEW CLIMATOLOGISTS IN THE 1950'S NOTICED THE TREND AND DECIDED THEY OUGHT TO STUDY IT.

**AVERAGE WORLD TEMPERATURE
TREND 1880-1975 (DOTS ARE INDIVIDUAL YEARS AND RED LINE
IS A 5 YEAR AVERAGE)**



WHEN THIS GRAPH IS CONTINUED TO 1975, THE TEMPERATURE FALLS OFF AGAIN, ABOUT 0.2°F IN THE AVERAGE (BLUE LINES, AGAIN). SOME INDIVIDUAL YEARS WERE MORE EXTREME. CLIMATOLOGISTS NOTICED THAT, TOO, AND BLAMED A POLLUTION HAZE THAT WAS INCREASING IN THICKNESS OVER THE WORLD. IT SEEMED TO BE SCREENING OUT SOME SUNLIGHT.



**THE
SOUTHERN TIP
OF LAKE
MICHIGAN
FROM A PLANE
APPROACHING
CHICAGO'S
O'HARE
AIRPORT
SOMETIME IN
THE LATE
1970'S OR
EARLY 1980'S**

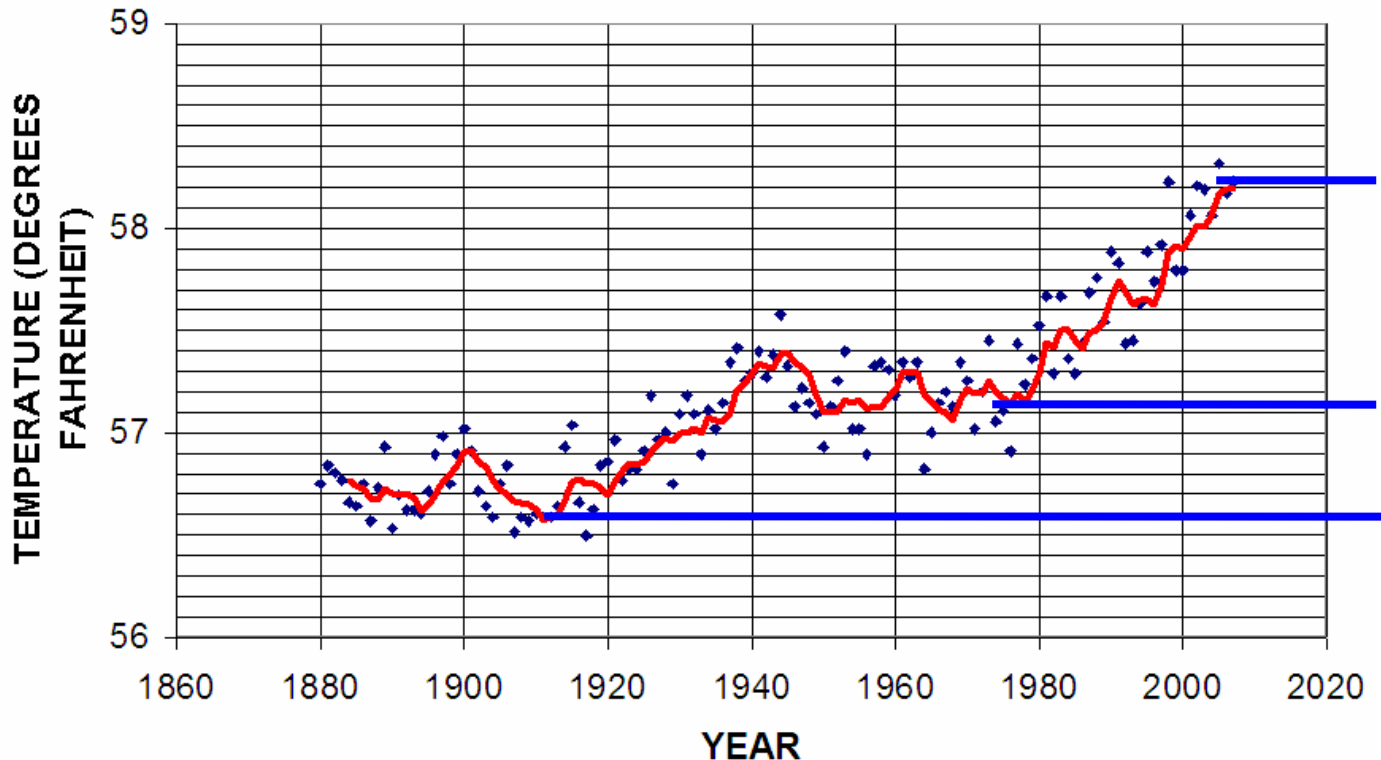
IT CAN BE HARD TO TELL THE DIFFERENCE BETWEEN POLLUTION HAZE, ORDINARY HAZE, AND ORDINARY CLOUDS. BUT A NUMBER OF OBSERVERS NOTICED THE HAZE INCREASING OVER WIDE AREAS. (IN FACT, I NOTICED IT MYSELF AS I TRAVELED AROUND DURING THOSE YEARS.) THEY SUGGESTED THAT THIS POLLUTION PROBLEM MIGHT EVENTUALLY GIVE THE EARTH QUITE A COOLING, IF IT WERE ALLOWED TO CONTINUE, AND IF NOTHING ELSE INTERFERED.



HAZE IN THE DISTANCE FROM THE TOP OF COLORADO'S MT. EVANS (14,240 FT.) WITH A YOUNG, 1970'S VERSION OF ME WATCHING. NO, I DIDN'T CLIMB IT. THERE IS A ROAD. (WHITE LINE RIGHT OF THE LAKE -- A ROAD THAT IS EITHER VERY EXCITING OR VERY DISORIENTING, DEPENDING ON YOUR TAKE ON HIGH PLACES - IN THE 70'S THEY WEREN'T EVEN CHARGING A TOLL YET.)

THERE WAS ALSO THE THEORY THAT GREENHOUSE GASSES RELEASED INTO THE ATMOSPHERE BY FUEL BURNING COULD WARM THE WORLD. BUT IN THE 1970'S, NOT MUCH WORK HAD BEEN DONE ON EITHER IDEA, SO IT WAS LITERALLY "UP IN THE AIR" WHETHER WARMING OR COOLING WOULD PREDOMINATE. HOWEVER, SEVERAL COOLING ADVOCATES MADE THEIR CASE FORCEFULLY THROUGH EVEN MORE FORCEFUL JOURNALISTS. SO WARNINGS OF AN IMPENDING ICE AGE BECAME COMMON FOR A WHILE. THESE ARE STILL THROWN INTO THE FACES OF PEOPLE NOW WARNING OF GLOBAL WARMING DESPITE THE HUGE VOLUMES OF RESEARCH DONE ON THE SUBJECT SINCE THE 1970'S.

**AVERAGE WORLD TEMPERATURE
TREND 1880-2007 (DOTS ARE INDIVIDUAL YEARS AND RED LINE
IS A 5 YEAR AVERAGE)**



WHEN THE TEMPERATURE GRAPH IS CONTINUED TO 2007, THE TEMPERATURE STARTS RISING RAPIDLY. SINCE 1975 THE AVERAGE GAINED 1.1°F (0.6°C) FOR A NET GAIN OF ABOUT 1.6°F (NEARLY 0.9°C) SINCE THE LOW POINT ABOUT 1912. NOW CLIMATOLOGISTS USUALLY ARGUE THAT THE MID-CENTURY COOLING WAS, INDEED, MOSTLY CAUSED BY HAZE IN THE ATMOSPHERE, BUT THAT GREENHOUSE WARMING HAS NOW OVERCOME IT. THE HAZE STILL EXISTS, AND THE TOTAL WARMING WOULD BE GREATER WITHOUT IT. THESE SLIDE SHOWS ARE GOING TO TAKE A GOOD LOOK AT THE REASONS FOR THINKING SO.

EARLIER TEMPERATURE RECONSTRUCTIONS:

(FOR THE PERIOD BEFORE THE INSTRUMENT RECORD AND AFTER THE ICE AGE. THIS IS FOR THE NORTHERN HEMISPHERE ONLY DUE TO LACK OF ANCIENT DATA FROM THE SOUTHERN HEMISPHERE.)

THESE STUDIES HAVE USED ICE CORES AND SEDIMENT CORES, SIMILAR TO WHAT WAS DESCRIBED IN CHAPTER 1, AND HAVE ADDED INDICATIONS OF TEMPERATURE FROM TREE RINGS, FROM THE CONDITION OF CORALS, AND OTHER SUCH EVIDENCE.

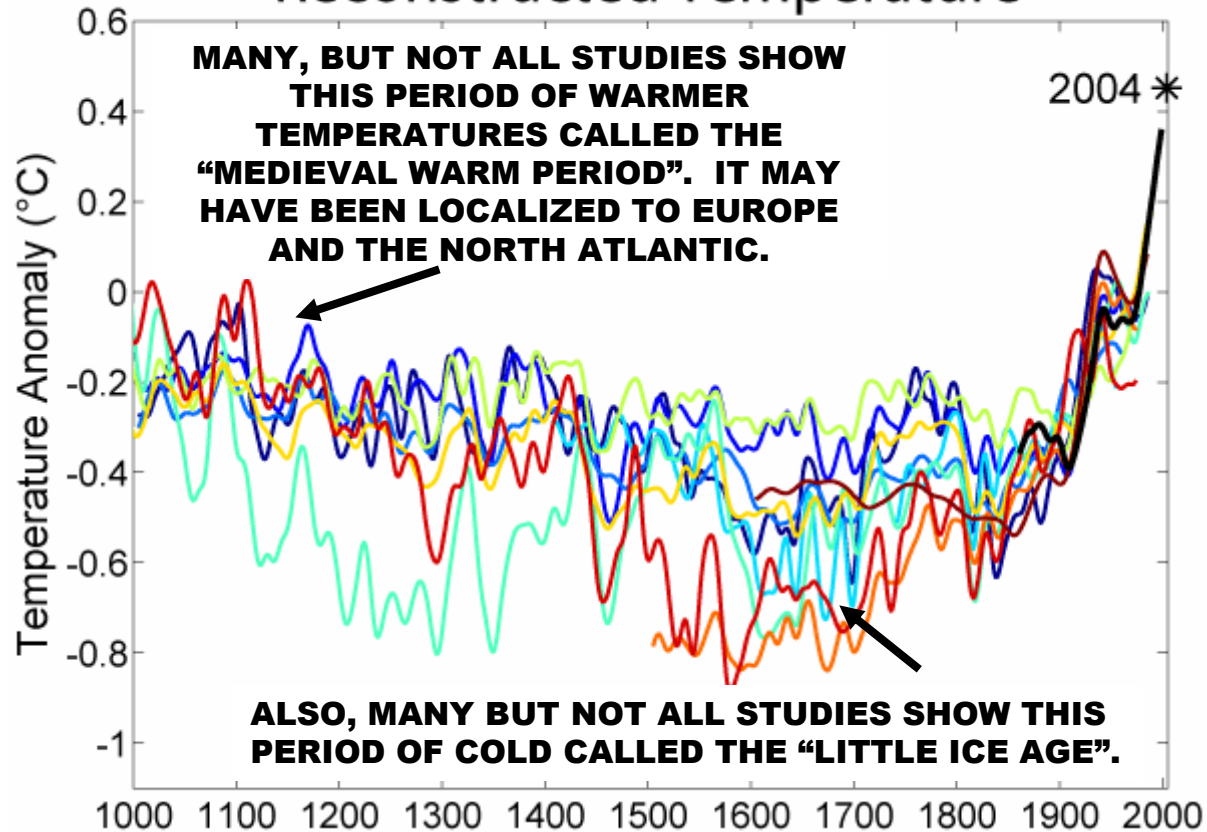
THIS FAMOUS STUDY, DATED FEB, 1994, FROM [MANN, BRADLEY, AND HUGHES](#), CONCLUDED THAT THE EARTH'S AVERAGE TEMPERATURE DIDN'T CHANGE MUCH IN ABOUT 1000 YEARS BEFORE THE SHARP, RECENT UPSWING. SEE A VERSION OF THEIR TEMPERATURE GRAPH [HERE](#). THE ORIGINAL BY MANN ET. AL. IS [HERE](#).

THUS THE CURRENT AVERAGE TEMPERATURE SEEMS HIGHER THAN ANY IN THE LAST 1000 YEARS.

Reconstructed Temperature

THIS PICTURE IS FROM THE [GLOBAL WARMING ART SITE](#). SEE MORE DETAIL THERE.

SOME OTHER VERSIONS WITH REFERENCES CAN BE SEEN [HERE](#).

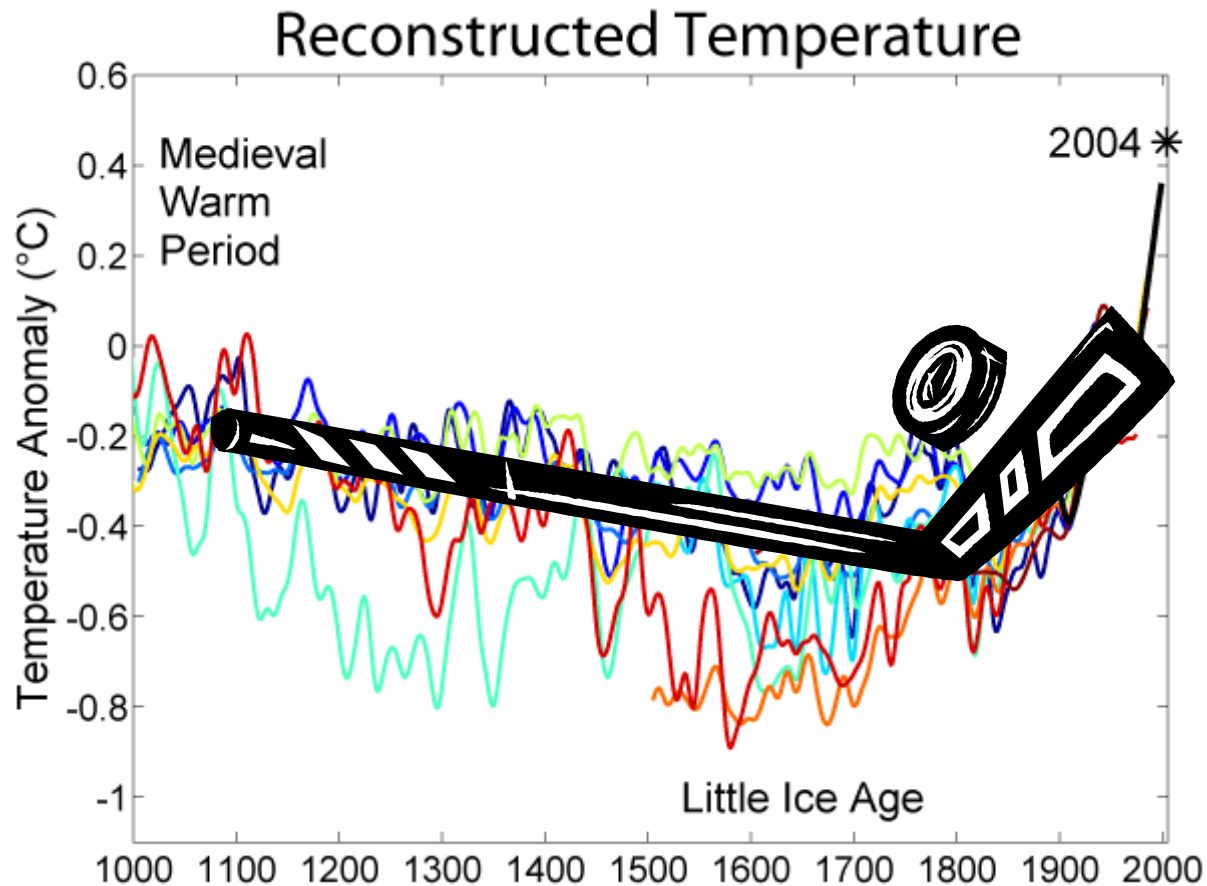


SEVERAL OF THESE RECONSTRUCTIONS OF ANCIENT TEMPERATURES BEFORE THE INSTRUMENT RECORD ARE SHOWN HERE. MANY SUCH TEMPERATURE RECONSTRUCTIONS SHOW THE MEDIEVAL WARM PERIOD AND THE LITTLE ICE AGE, BUT OTHERS, INCLUDING THE ORIGINAL ONE BY [MANN, BRADLEY, AND HUGHES](#), DO NOT.

SEE THIS [NOAA SITE](#) FOR A LONG LIST OF SOURCES FOR THESE AND SIMILAR GRAPHS.

THIS PICTURE
IS FROM THE
[GLOBAL
WARMING
ART SITE](#).
SEE MORE
DETAIL
THERE.

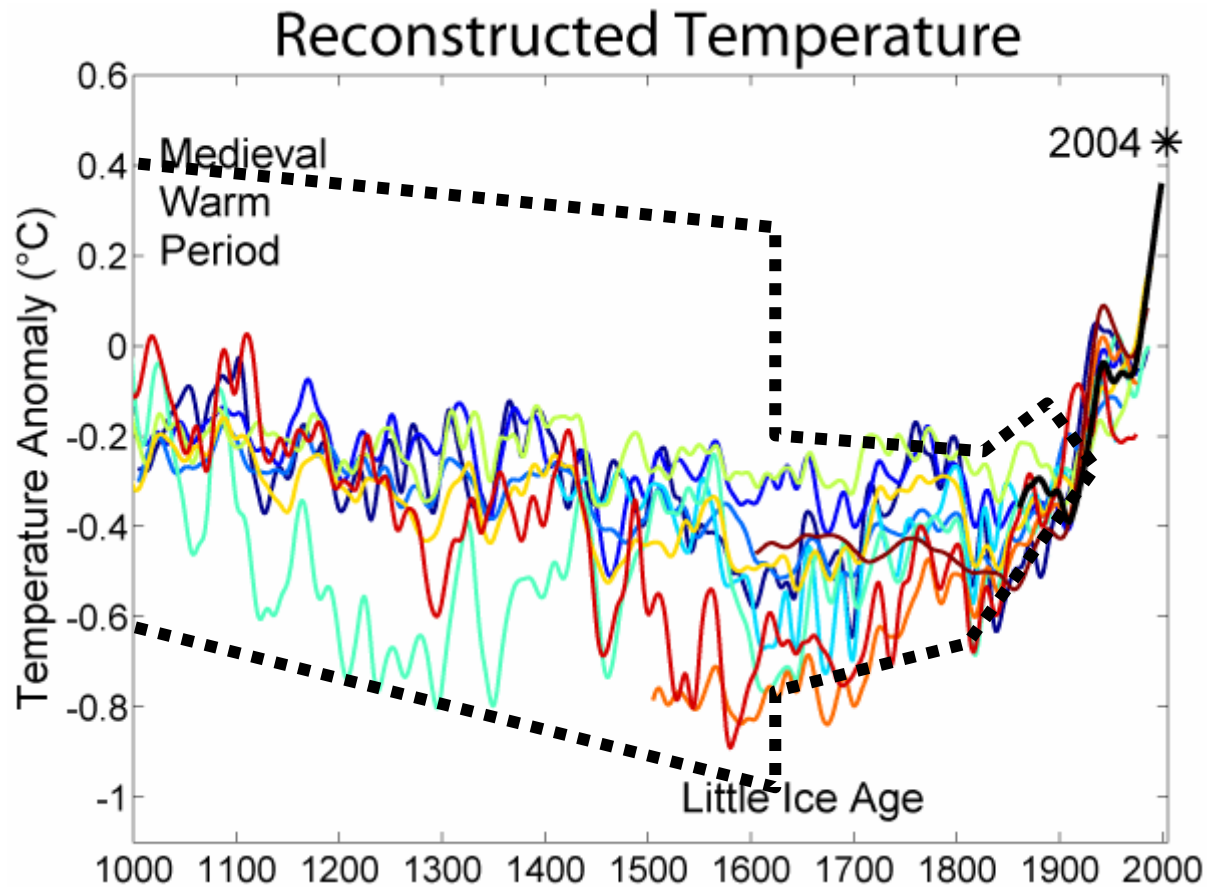
SOME OTHER
VERSIONS
WITH
REFERENCES
CAN BE SEEN
[HERE](#).



THESE HAVE OFTEN BEEN CALLED “HOCKEY STICK GRAPHS”. THE RISE IN TEMPERATURE TOWARD THE RIGHT END OF THE GRAPH IS THE SAME ONE THAT IS IN THE INSTRUMENT RECORD (BLACK LINE - SEE THE EARLIER SLIDES IN THIS CHAPTER). THE RECONSTRUCTIONS OF EARLIER TEMPERATURES (WAVY COLORED LINES) TEND TO JOIN INSTRUMENTAL RECORD, BUT THEY ARE NECESSARILY LESS CERTAIN.

THIS PICTURE
IS FROM THE
[GLOBAL
WARMING
ART SITE](#).
SEE MORE
DETAIL
THERE.

SOME OTHER
VERSIONS
WITH
REFERENCES
CAN BE SEEN
[HERE](#).



I HAVE DRAWN IN THE BLACK DOTTED LINE TO INDICATE, VERY ROUGHLY, THE LEVELS OF UNCERTAINTY [THAT ARE REPORTED](#) WITH SUCH GRAPHS. THE UNCERTAINTY GROWS AS THE YEARS RECEDE INTO THE PAST, ESPECIALLY BEFORE 1600.

THERE HAVE BEEN STRONG ATTACKS, SUCH AS IN A 2003 PAPER BY McINTYRE AND McKITRICK, AGAINST THIS “HOCKEY STICK GRAPH”, ESPECIALLY AGAINST THE FIRST VERSION BY [MANN, BRADLEY, AND HUGHES](#). THERE HAVE BEEN EQUALLY [STRONG DEFENSES](#).

HERE IS A PAPER IN WHICH [MCKITRICK](#) DESCRIBES THE CRITICISM. IT CONSISTS OF SOME STRONGLY WORDED ATTACKS AGAINST THE STATISTICAL METHODS USED, AGAINST MANN, AND AGAINST THE IPCC ITSELF, WHICH INCLUDED THE MANN GRAPH IN ITS 2001 REPORT. IT SUGGESTS THAT THE WHOLE HOCKEY STICK SHAPE INCLUDING THE RELATIVELY STRAIGHT “HANDLE” AND THE UPSWING AT THE RIGHT END WERE ARTIFICIALLY PRODUCED BY THE STATISTICAL METHODS USED BY MANN AND HIS COWORKERS.

MCKITRICK SUGGESTS STRONGLY THAT THE MEDIEVAL WARM PERIOD WAS WARMER THAN ANYONE HAD ADMITTED AND WAS, IN FACT EVEN WARMER THAN THE LATE 20TH CENTURY, WHEN TEMPERATURES WERE KNOWN TO BE RAPIDLY RISING.

THUS HE MAINTAINS THAT THERE IS NOTHING SPECIAL ABOUT THE CURENT WARMING.

MANY OTHERS DO NOT AGREE, HOWEVER. PLEASE READ ON.

**THERE IS A SUMMARY OF THE “HOCKEY STICK” CONTROVERSY [HERE](#).
THE WHOLE IDEA OF THE HOCKEY STICK IS TO TAKE MANY INDICATORS
OF ANCIENT TEMPERATURE FROM AROUND THE WORLD AND
STATISTICALLY WEAVE THEM INTO A RELIABLE GLOBAL AVERAGE.
THIS HAS NOT BEEN DONE, FOR EXAMPLE, FOR ICE AGE
TEMPERATURES WHERE WE ONLY HAVE DATA FROM A FEW LOCATIONS.**

**THESE INDICATORS ARE USUALLY CALLED TEMPERATURE “PROXIES”,
AND COMBINING THEM INTO A GLOBAL AVERAGE INVOLVES MUCH
COMPLICATED STATISTICAL WORK. MAINLY, THE CONTROVERSY HAS
FOCUSED ON HOW THE STATISTICS WERE DONE.**

**THE [ABOVE LINK](#) REVIEWS THE CREATION OF THE HOCKEY STICK, THE
CRITICISM, AND THE DEFENSE. MUCH OF THE DEFENSE INVOLVES THE
FACT THAT MANY OTHER RECONSTRUCTIONS OF ANCIENT
TEMPERATURES HAVE BEEN MADE, AND THEY ALL SHOW THE CURRENT
TEMPERATURE AS THE WARMEST IN THE LAST 1000 YEARS.
GENERALLY, HOWEVER, THEY DO SHOW MORE VARIATION IN THE LAST
1000 YEARS THAN THE ORIGINAL MANN ET. AL. PAPER.**

**EVENTUALLY CONGRESS GOT INVOLVED, WHICH PRODUCED TWO
ADDITIONAL STUDIES.**

**THE [WIKIPEDIA ARTICLE](#) ON THE SUBJECT CONTAINS A DETAILED
SUMMARY OF THE CONGRESSIONAL INVOLVEMENT AND THE TWO
STUDIES.**

**ONE WAS BY THE NATIONAL ACADEMY OF SCIENCES (NAS) IN 2006. IT
EXPRESSED A HIGH LEVEL OF CONFIDENCE IN THE DATA FOR THE MOST
RECENT 400 YEARS. HOWEVER, THE CONFIDENCE LEVEL WAS FOUND
TO BE LOWER FROM THERE BACK TO 900 AD, AND VERY LOW BEFORE
THAT. THIS GENERALLY PRESERVES CONFIDENCE IN THE HOCKEY
STICK GRAPHS, MOST OF WHICH GO BACK TO THE YEAR 1000.**

**(NOTE THAT THIS DOES NOT AFFECT ICE AGE STUDIES, 10,000 YEARS
AGO AND EARLIER, BECAUSE THERE HAS BEEN NO ATEMPT TO DO
GLOBAL AVERAGES OF THESE.)**

THE [WIKIPEDIA ARTICLE](#) ON THIS SUBJECT CONTAINS A DETAILED SUMMARY OF THE TWO STUDIES INSPIRED BY THE CONGRESSIONAL INVOLVEMENT.

THE OTHER SUCH STUDY, BY EDWARD WEGMAN AND ASSOCIATES, REMAINED VERY CRITICAL. IT GENERALLY AGREED WITH McINTYRE AND McKITRICK ABOUT THE MANN ET. AL. STUDY AND CRITICIZED THE OTHER RECONSTRUCTIONS OF ANCIENT TEMPERATURE ON THE GROUNDS THAT MOST OF THE RESEARCHERS TALKED TO ONE ANOTHER.

(ACTUALLY RESEARCHERS IN ANY SPECIALIZED FIELD TALK TO ONE ANOTHER. THAT IS HOW THEY CATCH ERRORS IN THEIR WORK, WHICH CAN OFTEN ONLY BE FOUND BY OTHERS SPECIALIZING IN WHATEVER IS BEING STUDIED. THESE SCIENTISTS ARE OFTEN VERY CRITICAL OF ONE ANOTHER, AND SUCH CONTACT DOES NOT MEAN THAT CHEATING IS GOING ON. SEE THE NEXT CHAPTER FOR MORE ON THIS.)

HERE IS MY RESOLUTION OF THE BIG STATISTICAL CONTROVERSY...

ER, UH, OK, JUST KIDDING. I DON'T BEGIN TO HAVE THE BACKGROUND IN STATISTICS FOR THAT. BUT HERE ARE A FEW OBSERVATIONS:

- 1. THE CRITICISM SUGGESTS THAT PROPER STATISTICAL METHODS WOULD HAVE SHOWN MORE VARIABILITY EARLIER ON INCLUDING A MEDIEVAL WARM PERIOD WARMER THAN PRESENT TEMPERATURES. PROPER METHODS MIGHT NOT HAVE SHOWN THE CURRENT TEMPERATURE UPTURN, ACCORDING TO THE CRITICS.**
- 2. BUT EVEN IF TRUE, THIS DOESN'T EXPLAIN WHAT IS HAPPENING NOW. THE RECENT UPTURN IN THE GLOBAL TEMPERATURE HAS BEEN OBSERVED BY INSTRUMENTS (THERMOMETERS), NOT ONLY BY INTERPRETING FOSSILS. THIS UPTURN IN TEMPERATURE IS REAL.**
- 3. FURTHERMORE, AS WILL BE SEEN IN LATER CHAPTERS, POSSIBLE REASONS FOR THE CURRENT UPTURN IN TEMPERATURE HAVE BEEN VERY INTENSELY STUDIED BY MANY RESEARCHERS. THIS TYPE OF WORK SUGGESTS PRETTY STRONGLY THAT THE CURRENT UPTURN CANNOT BE EXPLAINED WITHOUT THE EFFECTS OF HUMAN-PRODUCED GREENHOUSE GASSES.**

MY OBSERVATIONS, CONTINUED...

- 4. SO WHATEVER CAUSED ANY MEDIEVAL WARM PERIOD OR LITTLE ICE AGE, IT WAS NOT VERY LIKELY TO HAVE BEEN THE SAME THING OPERATING NOW. HUMANS WERE JUST NOT RELEASING THOSE GASSES THEN. THE CAUSES OF THE EARLIER EVENTS ARE NOT CLEAR BUT MAY HAVE INCLUDED VARIATIONS IN SOLAR OUTPUT. ALSO THESE EVENTS MAY HAVE BEEN LOCALIZED IN EUROPE AND THE NORTH ATLANTIC, ACCORDING TO SOME RESEARCHERS.**
- 5. THERE HAVE BEEN MANY OTHER RECONSTRUCTIONS OF ANCIENT TEMPERATURE. ALMOST ALL OF THEM SHOW THE CURRENT TEMPERATURE TO BE LARGER THAN ANY IN THE LAST 1000 YEARS. HOWEVER, MOST OF THEM DO SHOW MORE VARIATION IN THE LAST 1000 YEARS THAN THE ORIGINAL MANN ET. AL. STUDY AND MANY SHOW A MEDIEVAL WARM PERIOD ALTHOUGH ONE THAT WAS NOT QUITE AS WARM AS NOW.**
- 6. SO THE HOCKEY STICK CRITICISM IS PROBABLY AT MOST ONLY PARTLY TRUE. BUT EVEN IF IT IS ENTIRELY TRUE, IT DOESN'T MATTER. THE EXISTENCE OF WARM MEDIEVAL TEMPERATURES, EVEN IF WARMER THAN NOW, DOESN'T NEGATE THE FACT THAT SOMETHING IS HAPPENING TO GLOBAL TEMPERATURE NOW.**

ANOTHER INTERESTING TEMPERATURE WEB SITE:

EXPLORE THE TEMPERATURE TRENDS OF BITS AND PIECES OF THE EARTH – OR OF THE WHOLE WORLD AT THIS NOAA* SITE.

YOU WILL BE ABLE TO ENTER VARIOUS REGIONS OF THE WORLD (EXAMPLE: NORTH AMERICA) OR TO LOOK AT THE TEMPERATURE TREND FOR THE WHOLE WORLD. YOU CAN ALSO SEE THE DATA FROM VARIOUS DIFFERENT RESEARCH GROUPS.

YOU WILL NOTICE THAT NORTH AMERICA HAS NOT QUITE FOLLOWED THE GLOBAL TREND. I HAVE SEEN SOME DISCUSSIONS ON THE INTERNET THAT CONFUSED THE TWO, TRYING TO USE NORTH AMERICAN DATA TO PROVE THAT THE WORLD IS NOT WARMING. IN FACT, THE WARMING SEEMS TO BE STEEPER IN THE SOUTHERN HEMISPHERE.

THE SITE IS AT: <http://www.ncdc.noaa.gov/gcag/gcag.html>

*** NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION – THE PEOPLE WHO BRING YOU THE WEATHER**

We have seen some issues raised by skeptics. There are also other such issues. Here are two potentially serious ones which have received wide publicity.

- 1. Is the warming just the effect of greater heat put out by growing cities around the weather stations?**
- 2. Some temperature measurements by satellite did not always seem consistent with the measurements on the ground.**

These issues have been ironed out, as described in Chapters 4 and 5. But before checking into why, lets look at the role of skepticism itself in science.

REFERENCES: Web addresses (paste to your browser, if necessary)

SLIDE 16

http://pubs.giss.nasa.gov/docs/1999/1999_Hansen_etal.pdf (Global Temperature Research Paper)

SLIDE 17

<http://www.ipcc.ch/about/index.htm> (IPCC Description)

http://www.wmo.int/pages/index_en.html (World Meteorological Organization)

<http://www.unep.org/> (United Nations Environment Program)

<http://www.ipcc.ch/> (IPCC Home Page)

THE NEXT FOUR LINKS ARE TO THE IPCC 4TH ASSESSMENT REPORT (2007)

http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf (Summary for Policy Makers)

<http://www.ipcc.ch/ipccreports/ar4-wg1.htm> (Physical Science Basis)

<http://www.ipcc.ch/ipccreports/ar4-wg2.htm> (Impacts)

<http://www.ipcc.ch/ipccreports/ar4-wg3.htm> (Mitigation)

http://www.grida.no/climate/ipcc_tar/wg1/index.htm (IPCC 3RD ASSESSMENT REPORT (2001))

REFERENCES: Web addresses (paste to your browser, if necessary)

SLIDE 18

<http://www.giss.nasa.gov/> (Goddard Institute for Space Studies [GISS])

<http://data.giss.nasa.gov/gistemp/graphs/> (GISS Climate Graphs)

<http://data.giss.nasa.gov/gistemp/graphs/Fig.A2.lrg.gif> (GISS Temperature Record)

<http://www.metoffice.gov.uk/research/hadleycentre/index.html> (Hadley Center)

<http://hadobs.metoffice.com/hadcrut3/diagnostics/index.html> (Hadley Climate Graphs)

<http://hadobs.metoffice.com/hadcrut3/diagnostics/global/nh+sh/> (Hadley Temperature Record)

SLIDE 19

<http://data.giss.nasa.gov/gistemp/tabledata/GLB.Ts+dSST.txt> (GISS Temperature Data)

<http://data.giss.nasa.gov/gistemp/2007/> (More Information From GISS)

SLIDE 26

<http://www.ncdc.noaa.gov/paleo/pubs/millennium-camera.pdf> (Mann, Bradley, Hughes Study)

http://en.wikipedia.org/wiki/Image:Hockey_stick_chart_ipcc_large.jpg (Mann Hockey Stick Graph)

http://www.ncdc.noaa.gov/paleo/pubs/mann_99.html (Original Mann Hockey Stick Graph)

REFERENCES: Web addresses (paste to your browser, if necessary)

SLIDE 27

http://www.globalwarmingart.com/wiki/Image:1000_Year_Temperature_Comparison_png
(Other Graphs Showing Temperature for the Last 1000 Years at Global Warming Art Site)

http://environment.newscientist.com/data/images/ns/cms/mg18925431.400/mg18925431.400-2_752.jpg

(Other Versions of the 1000 Year Temperature Graph with References)

http://www.ncdc.noaa.gov/paleo/pubs/mann_99.html (Original Hockey Stick Graph – From Slide 26)

<http://www.ncdc.noaa.gov/paleo/recons.html> (Sources for Graphs on Slide 27)

SLIDE 28

(The two links here are the same as the first two on Slide 27.)

SLIDE 29

(The three links here are the same as the first three on Slide 27.)

SLIDE 30

<http://www.ncdc.noaa.gov/paleo/pubs/millennium-camera.pdf> (Mann et. al. Research paper)

<http://holocene.meteo.psu.edu/Mann/EandEPaperProblem.pdf> (Defense of Hockey Stick Graph)

<http://www.climatechangeissues.com/files/PDF/conf05mckitrick.pdf>
(Criticism of Hockey Stick Graph)

REFERENCES: Web addresses (paste to your browser, if necessary)

SLIDE 31

<http://environment.newscientist.com/channel/earth/mg18925431.400>

(Summary of Hockey Stick Controversy)

(The second link on this slide is the same as the first.)

SLIDES 32 AND 33

http://en.wikipedia.org/wiki/Hockey_stick_controversy

(Congressional Involvement in Hockey Stick Controversy and Studies Ordered by Congress)

SLIDE 36

<http://www.ncdc.noaa.gov/gcag/gcag.html> (Temperature Graphs for Parts of the World)



**CONTINUE ON AND RETURN TO
THE GLOBAL WARMING MENU**

**THEN LOOK AT
CHAPTER 3
“Scientists must be
skeptics”**