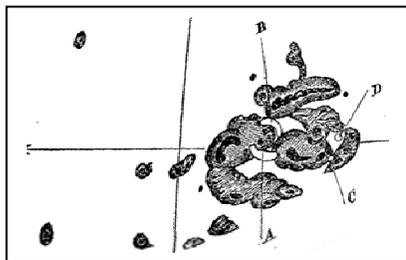


Monster Sunspots!

Sunspots have been observed for thousands of years because, from time to time, the sun produces spots that are so large they can be seen from Earth with the naked eye...with the proper protection. Ancient observers would look at the sun near sunrise or sunset when Earth's atmosphere provided enough shielding to very briefly look at the sun for a few minutes. Astronomers keep track of these large 'super spots' because they often produce violent solar storms as their magnetic fields become tangled up into complex shapes.

Below are sketches and photographs of some large sunspots that have been observed during the last 150 years. They have been reproduced at scales that make it easy to study their details, but do not show how big they are compared to each other.

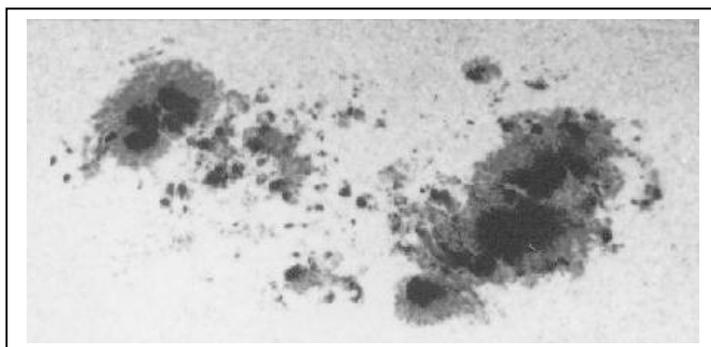
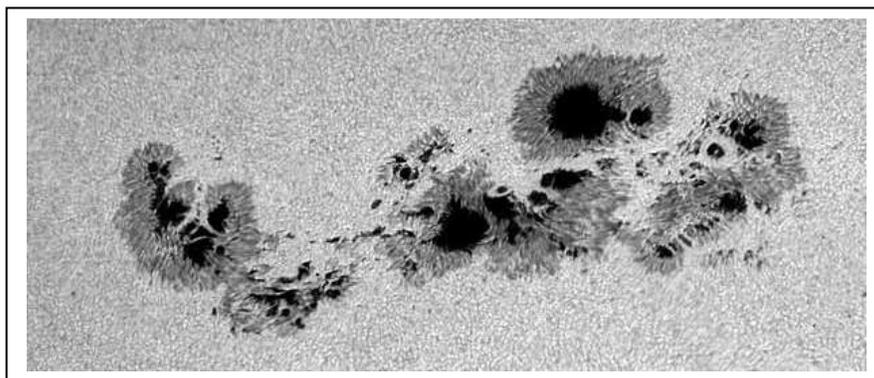
Problem: By using a millimeter ruler, use the indicated scales for each image to compute the physical sizes of the three sunspots in kilometers. Can you sort them by their true physical size?



Top is the sunspot drawn by Richard Carrington on August 28, 1859 at a scale of 5,700 kilometers/mm.

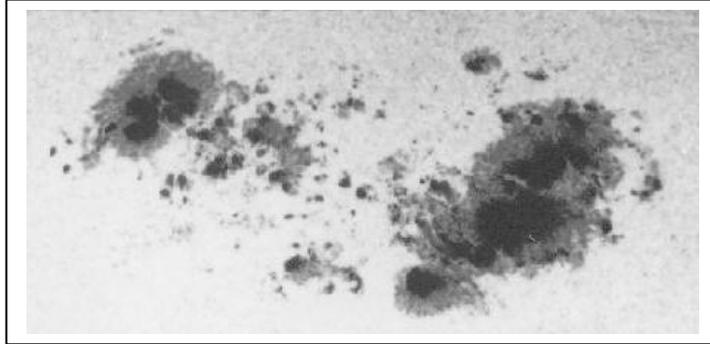
Middle is a photograph of a sunspot seen on March 29, 2000 at a scale of 23,500 kilometers/cm.

Bottom is a sunspot seen on April 8, 1947 at a scale of 100,000 kilometers/inch

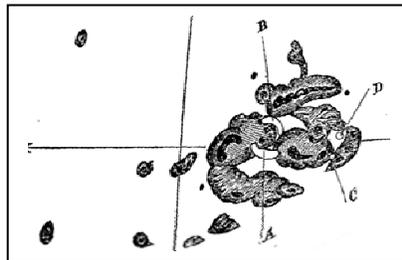


Answer Key:

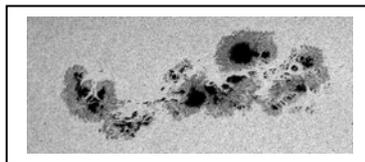
Images ordered from largest to smallest and to scale:



Sunspot seen on April 8, 1947 reproduced at a scale of 100,000 kilometers/inch. The linear extent on the page is 7 centimeters, so the length in inches is $7 / 2.5 = 2.8$ inches. The true length is then $2.8 \times 100,000 = \underline{280,000 \text{ kilometers}}$.



The sunspot drawn by Richard Carrington on August 28, 1859 at a scale of 5,700 kilometers/mm. With a ruler, the distance from the left to the right of the group is about 40 millimeters, so the true length is about $40 \times 5,700 = \underline{228,000 \text{ kilometers}}$.



A photograph of a sunspot seen on March 29, 2000 at a scale of 23,500 kilometers/cm. The length of the spot is 90 millimeters or 9 centimeters. The true length is then 211,500 kilometers.