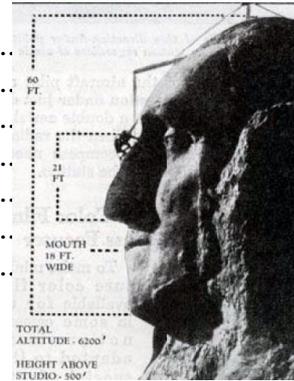


THE MOUNT RUSHMORE PLUMB BOBS

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0. INTRODUCTION

Dear Fellow Collector,

Last year I wrote about the plumb bobs used in the construction of the Washington Monument¹.

Another National Monument of extraordinary physical stature are the famous sculptures at Mount Rushmore in the Black Hills of South Dakota. Logic would dictate that like all construction projects the plumb bob played a role in the sculpting of the presidents on the stone face of the mountaintop. Unlike the shape of the Washington Monument which is quite regular in its geometry and therefore a relatively straightforward application of the plumb bob and plumb line, I felt it would be interesting to find out how the simple plumb bob was adapted to an application of construction as irregular as the faces of the four presidents on an even more irregular stone surface.

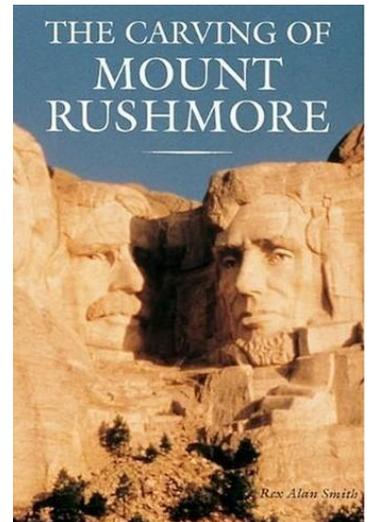


What is important to remember is that the artist could conceptualize the recognizable facial features of his four subjects in a large but reduced scale studio model. It is quite another matter for those exact features and proportions to be transferred to the mountainside to figures twelve times larger than the model. Dangling from cables, with no sense of perspective of the overall view, workers with stone working tools had to work to remove stone to specific points of reference, proportional to the studio concept.

Employing a principle somewhat like a pantograph an interesting application of the use of the plumb bob was employed to transfer the proportions of the artist's model to the immense stone face on the mountainside. Searching in the www for Mount Rushmore, you get thousands of pages, but only a few mention the role of the plumb bob used to build this monument.

Knowing that there must have been a special plumb bob in use on the site I asked the National Park Service, NPS, for some specific information. Their first response was not very promising:

"Hello Wolf, we unfortunately do not have any history of the pointing system online or on our website. There are some historic photographs on our website, but we don't have any that specifically show the plumb bob in use. I also unfortunately don't have a photo of our second plumb bob. I have two photographs in our archives that I have attached here. They are pictures of the upper part of the pointing system, but I don't have photos specifically of the plumb bob...Rex Alan Smith's book "The Carving of Mount Rushmore²," actually has more photographs than what I have concerning the pointing system. He also has a good general explanation of the creation and use of the pointing system."



I will not attempt to rewrite any of the fine articles about Mount Rushmore. Rather, I will chart a new emphasis the things of interest to the plumb bob collector. The other information you can get from the world wide web.

The official web site of the National Park Service NPS is: <http://www.nps.gov/moru/index.htm>
Other sources see foot notes on the last page.

1. MOUNT RUSHMORE + MUSEUM

Some general information (from Wikipedia³)

Mount Rushmore National Memorial is a sculpture carved into the granite face of Mount Rushmore near Keystone, South Dakota in the United States. Sculpted by Gutzon Borglum and later by his son Lincoln Borglum, Mount Rushmore features 60-foot (18m) sculptures of the heads of former United States presidents (in order from left to right) George Washington, Thomas Jefferson, Theodore Roosevelt, and Abraham Lincoln. The entire memorial covers 1,278.45 acres (5.17 km²) and is 5,725 feet (1,745m) above sea level.

South Dakota historian Doane Robinson is credited with conceiving the idea of carving the likenesses of famous people into the Black Hills region of South Dakota in order to promote tourism in the region. Robinson's initial idea was to sculpt the Needles; however, Gutzon Borglum rejected the Needles site and chose the larger Mount Rushmore. Borglum also decided the sculpture should have a more national focus, and chose the four presidents whose likenesses would be carved into the mountain. After securing federal funding, construction on the memorial began in **1927**, and the presidents' faces were completed between 1934 and 1939. Upon Gutzon Borglum's death in March 1941, his son Lincoln Borglum took over construction. Though the **initial concept called for each president to be depicted from head to waist**, lack of funding forced construction to end in October **1941**.

The U.S. National Park Service took control of the memorial in 1933, while it was still under construction, and manages the memorial to the present day. It attracts approximately two million people annually”.

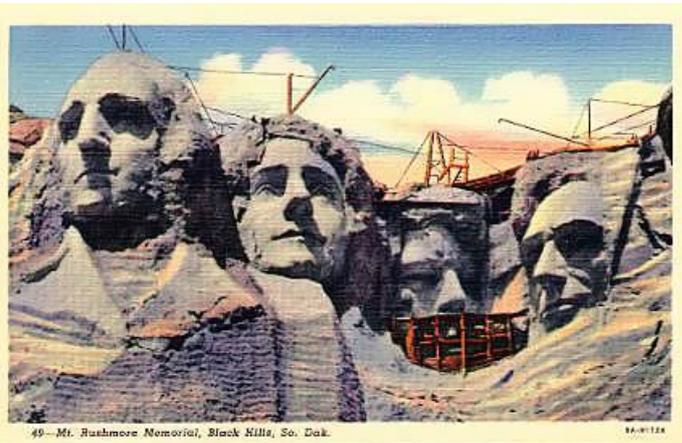
FAQ'S to the NPS see:

<http://www.nps.gov/moru/faqs.htm>

After several false starts regarding the site and subject matter for the memorial, Borglum's demand for a national rather than a regional monument prevailed and the 6,000 feet high outcrop of Mount Rushmore became the future site of a monument to the “Empire Builders” of the nation – the four U. S. presidents George Washington (as a leader of the American Revolution), Thomas Jefferson (for completing the Louisiana Purchase), Abraham Lincoln (for winning the Civil War and maintaining the Union), and Theodore Roosevelt (for construction the Panama Canal).



The Museum



Postcard



Drilling holes

2. SCULPTOR GUTZON BORGLUM

From Wikipedia⁴:

(John) Gutzon de la Mothe Borglum (March 25, 1867 – March 6, 1941) was an American artist and sculptor famous for creating the monumental presidents' heads at Mount Rushmore, South Dakota, the famous carving on Stone Mountain near Atlanta, as well as other public works of art.

The son of Danish immigrants, Gutzon Borglum was born in 1867 in St. Charles, Idaho. His father worked mainly as a woodcarver. At the age of seven, he moved to Nebraska, and later graduated from Creighton Preparatory School. He was trained in Paris at the Académie Julian, where he came to know Auguste Rodin and was influenced by Rodin's impressionistic light-catching surfaces. Back in the U.S. in New York City he sculpted saints and apostles for the new Cathedral of Saint John the Divine in 1901, in 1906 got a group sculpture accepted by the Metropolitan Museum of Art—the first sculpture by a living American the museum had ever purchased—and made his presence further felt with some portraits. He also won the Logan Medal of the Arts.

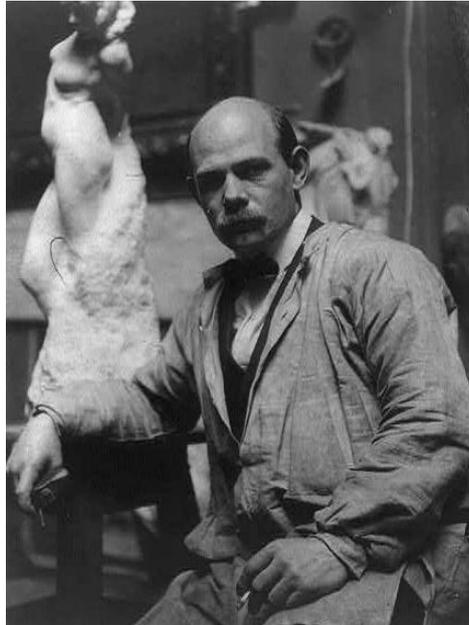
After graduation from Harvard Technical College, his reputation surpassed that of his younger brother, Solon Borglum, already an established sculptor.

A fascination with gigantic scale and themes of heroic nationalism suited his extroverted personality. His head of Abraham Lincoln, carved from a six-ton block of marble, was exhibited in Theodore Roosevelt's White House and can be found in the Capitol Rotunda in Washington, D.C. A patriot, believing that the "monuments we have built are not our own," he looked to create art that was "American, drawn from American sources, memorializing American achievement" according to a 1908 interview article. His equation of being "American" with being born of American parents—"flesh of our flesh"—was characteristic of nativist beliefs in the early 20th century. Borglum was highly suited to the competitive environment surrounding the contracts for public buildings and monuments, and his public sculpture is sited all around the United States.

From WIKIPEDIA⁵:

His Mount Rushmore project, 1927-1941, was the brainchild of South Dakota state historian Doane Robinson. His first attempt with one of the faces was blown up after two years. Dynamite was also used to remove large areas of rock from under Washington's brow. The initial pair of presidents, George Washington and Abraham Lincoln, was soon joined by Thomas Jefferson and Theodore Roosevelt.

Borglum alternated exhausting on-site supervising with world tours, raising money, polishing his personal legend, sculpting a Thomas Paine memorial for Paris and a Woodrow Wilson one for Poland. In his absence, work at Mount Rushmore was overseen by his son Lincoln. During the Rushmore project, father and son were residents of Beeville, Texas. When he died in Chicago, following complications after surgery, his son finished another season at Rushmore, but left the monument largely in the state of completion it had reached under his father's direction.



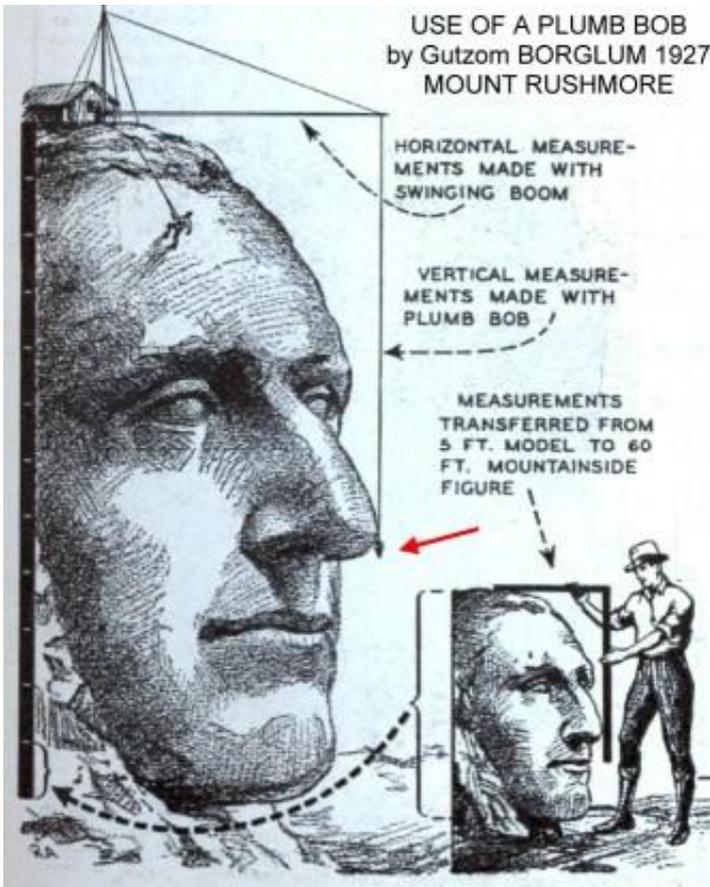
3. THE POINTING SYSTEM

For us of interest are the pointing system and the used materials. A very good description was printed 1933 in Modern Mechanix⁶:

WORLD'S LARGEST STATUE CARVED IN MOUNTAIN

The world regards with awe the stupendous sculptural achievements of the ancient engineers who built the Egyptian Sphinx, the Colossus of Rhodes and the Pyramids, but now it has a new monumental edifice to marvel at which dwarfs the projects of the ancients to almost insignificant proportions.

In the Black Hills of South Dakota a group of engineers, captained by the famous sculptor-engineer, Gutzon Borglum, are carving from a mountain of living granite the figures of Washington, Jefferson and Lincoln, whose faces alone measure sixty feet from chin to cranium top—twice the height of the face of the Sphinx of Gizeh.



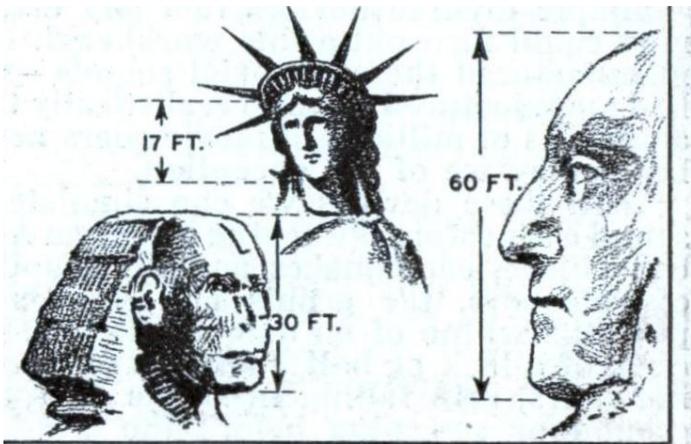
“Next I made a working model of Washington which was five feet from the chin to the top of his head. This model was taken to the top of Rushmore and used to guide the carving of the great stone head.

“The measurements taken from the working models are multiplied by twelve—an inch on the model being a foot on the statue—and are transferred to the granite of Mount Rushmore with the aid of a 30 ft. swinging boom and plumb bob”.

“This boom swings horizontally through a graduated arc of 180 degrees. The plumb bob may be suspended from any point upon it. After setting the angle, the distances horizontally outward and vertically downward to the rock are measured by tape. Skillful engineering here is as important to the work as artistic modeling.

“When the work was first begun, I picked the largest sound piece of granite for the figure of Washington,” Mr. Borglum continued. “The carving of the rock monument consisted in excavating the excess granite by a process of drilling and blasting which removes successive thin layers without injuring the mountain itself. As little as ten inches of granite can be moved at one time.

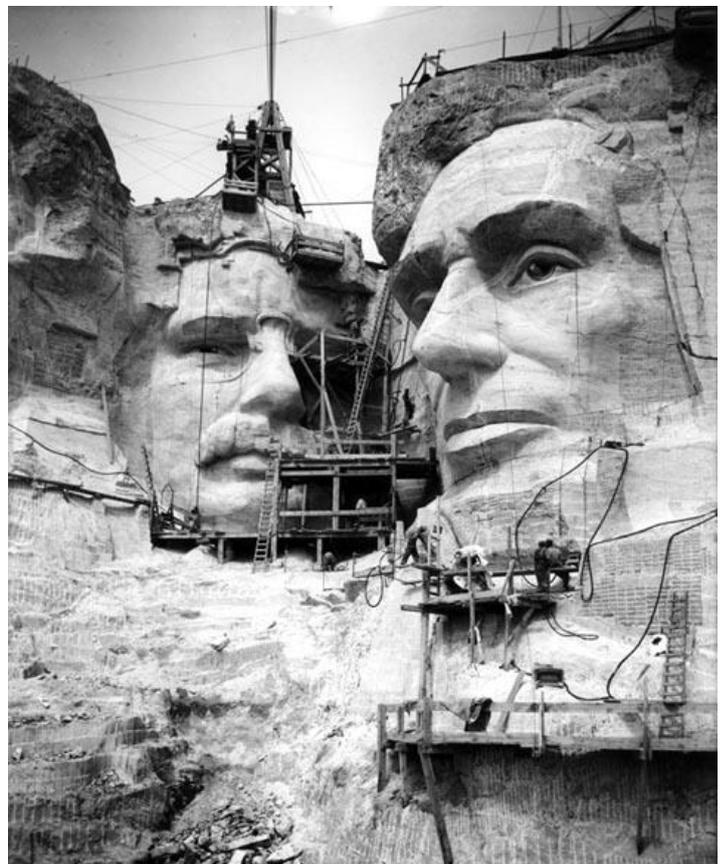
Borglum Explains Engineering Procedure



How Rushmore faces compare with Sphinx of Gizeh and Statue of Liberty. Left—drawing illustrates manner of transferring measurements from 5 ft. model to huge mountainside figure.

In a special interview with a MODERN Mechanix correspondent, Mr. Borglum explained the engineering procedure by which he is attacking his titanic job.

“First,” the bronzed and rugged sculptor said, “I prepared a small scale model to get the proper grouping of the three figures. This work was done in a studio with a great plate glass window looking out upon Rushmore.



Engineers Work in Safety Harness

“This process proceeds to within a few inches of the final surface, and then the finishing is done by a ‘broaching’ process



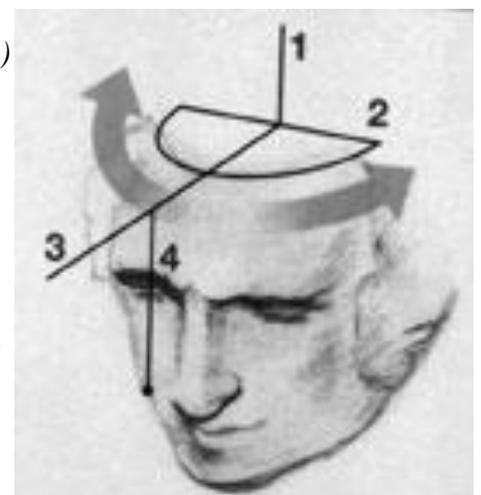
A photo of the THREE figures in the studio, before Roosevelt was added.

A better photo of Gutzon Borglum's model of Mt. Rushmore memorial--Washington, Jefferson, Roosevelt & Lincoln c. 1936 you can see on www7:

THE POINTING SYSTEM⁸

Measurements were taken from the model and applied to the mountain carving using the pointing system. The way the pointing system worked was a metal shaft (1) was placed upright at the center of the model's head. Attached at the base of the shaft was a protractor plate (2), marked in degrees, and a horizontal ruled bar (3) that pivoted to measure the angle from the central axis. A weighted plumb line (4) hung from the bar; it slid back and forth to measure the distance from the central head point, and raised and lowered to measure vertical distance from the top of the head.

Thus, each point on the model received three separate measurements. The number was multiplied by 12 (angles remained the same) and transferred to the granite face via a large scale pointing system anchored at the top of each head. Every inch on the model equals one foot on the mountain.



“There are no reserved seats at Rushmore. Workmen when engaged in actual carving are suspended over the edge of the cliff in steel and leather harnesses attached to a 3/8 inch steel cable. These cables are ‘paid out’ or reeled in by hand winches.

“Usually ten Ingersoll-Rand ‘R12 Jack-hammer’ drills are on the job for the rougher work. When in use these, too, they are attached to cables. The drills are 7/8 inch steel finished with cross bits.

“All drilling is dry. On the head of the three figures, now roughly completed, the drill holes were from 10 to 12 inches deep, about three inches apart and set about six inches from the face.

“About a 40 per cent special gelatin dynamite is used in each hole. The cap wires of a row of holes, usually from 60 to 75, are connected and the charges in the row of holes are fired simultaneously by means of a 110-volt power circuit. The dynamite does its work rapidly and smoothly.

“When blasting has brought the work to within three or four inches of the finished surface, another procedure is employed for the final ‘sculpturing.’ Holes three or four inches in depth are drilled vertically into the face at intervals of about three inches over the entire surface.

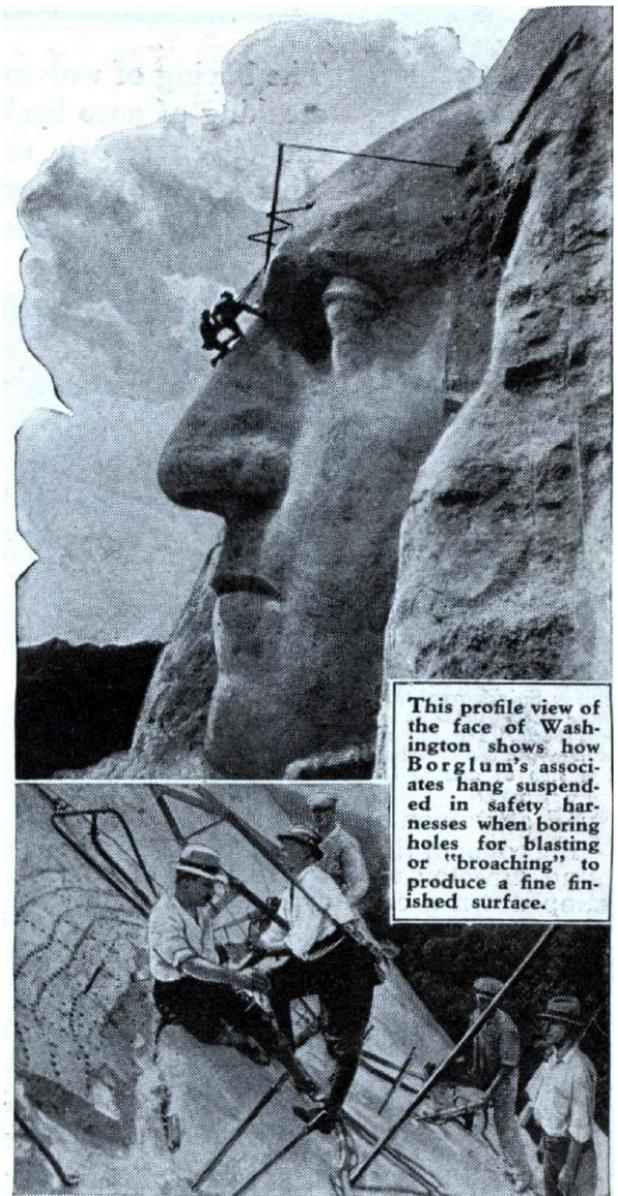
“Chisel bits are used in this step, as they do faster work. Once all the holes have been drilled, the rock between is ‘broached’ out with the aid of short pointed steel gads driven by plugger drills. Broaching produces the finer finished surface.”

POINTING SYSTEM:⁹

...Pointing involves transferring as many locations as needed (sometimes thousands) along the surface of a study model, typically a human figure, as well as marking the depth of the hole to be drilled into the finishing model. After locating enough points around an area, assistants could then cave short of the finished surface, allowing the sculptor to complete the figure. ...

The POINTER:¹⁰

As Borglum's son noted, the pointer was a more modern figure, part technician and part project manager rather than artisan. As a pointer for Mount Rushmore starting in 1933 Lincoln Borglum recounted that, the "pointer" was the most important man on the mountain, next to the sculptor, since he was responsible for all measurements and approved all drilling and blasting. In the day-to-day operation, he had to constantly lay out new work so there would be no delay in placing the workmen to the greatest advantage, and he was the one who must be able at all times to tell the sculptor how much stone there was at any given points." Borglum senior was mostly removed from the daily work on the memorial, stipulating in his contract that he would visit the site on an irregular basis and be directly involved only in the finishing of the surface.



On LINCOLN'S HEAD¹¹

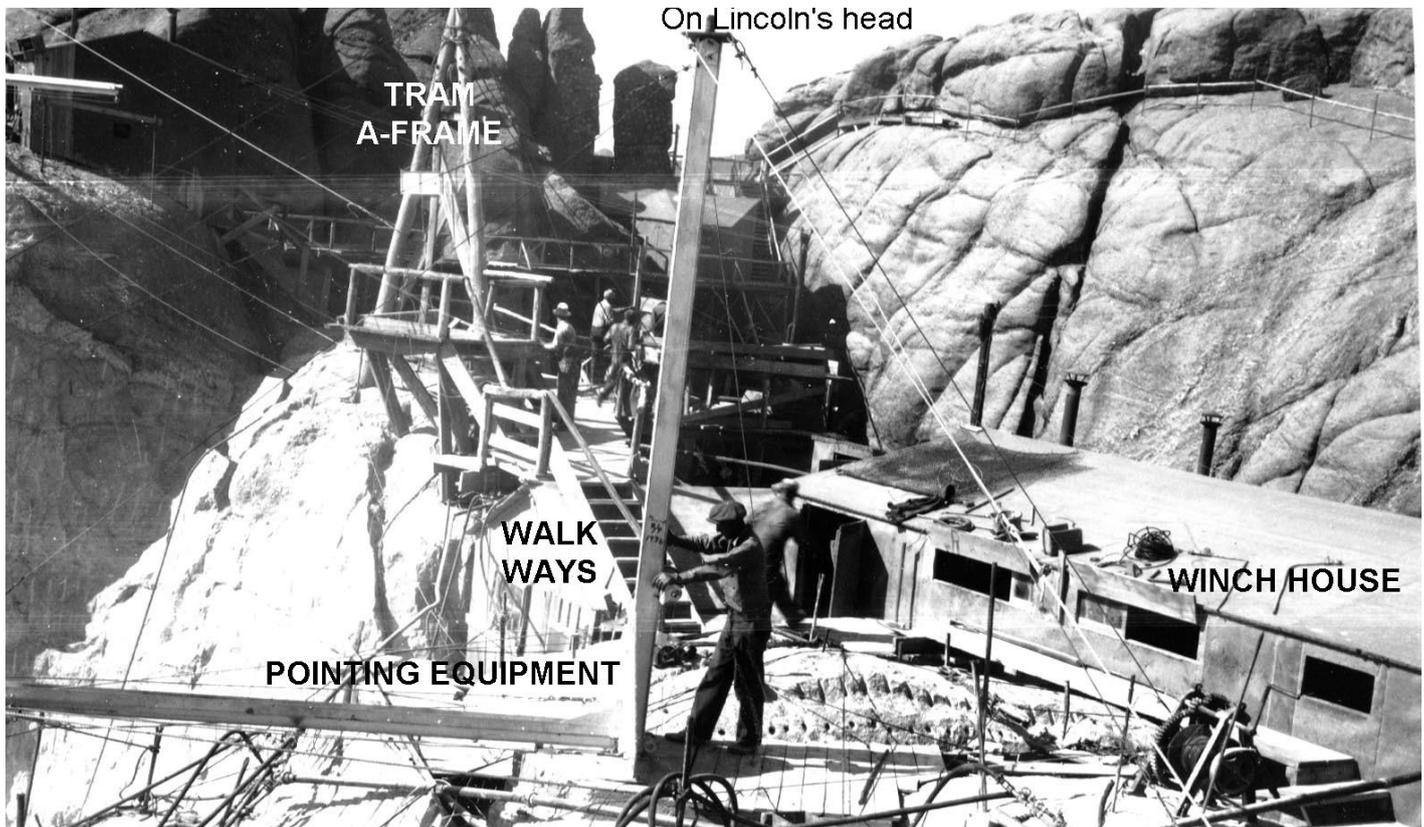
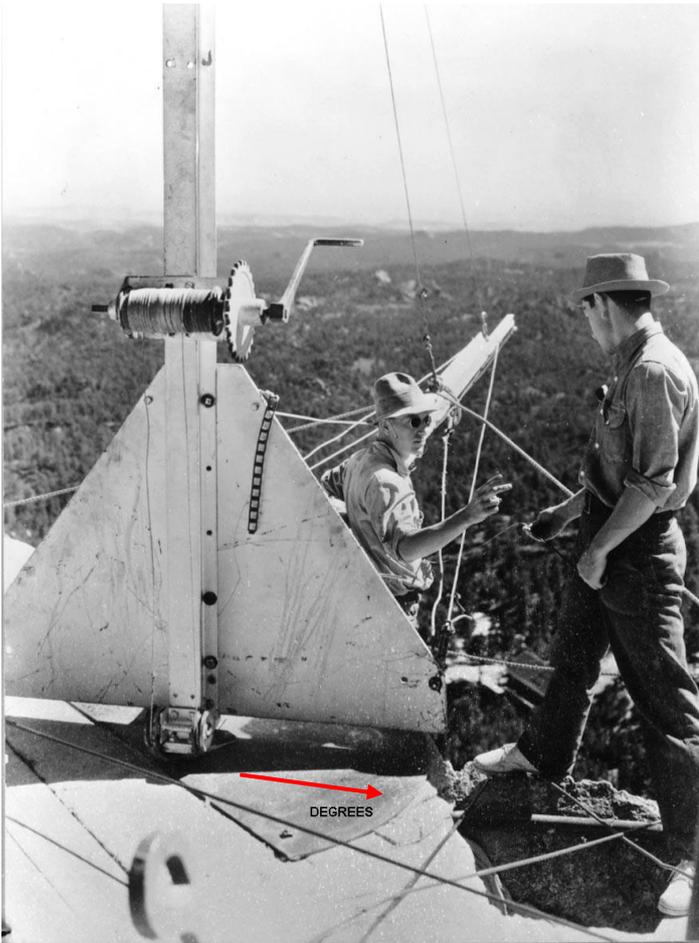


Figure below: Jim Larne and Lincoln Borglum, standing on head beside pointing machine. Ca. 1936-1939¹²



4. THE PLUMB BOBS

The NPS has two original plumb bobs in the collection. There is NO MERCURY FILLED plumb bob (as mentioned in some newspapers). It is likely that they were made onsite during the time of construction.

The catalog description from the NPS reads: “13 1/2 inch steel plumb bob, fastened at the top, pointed at opposite end. Used in transferring measurements from studio models to memorial figures.”



Working on the models they used a common six sided / hexagon plumb bob.¹³



Mount Rushmore
PLUMB BOB #1



Not to see on the photo: The plumb bob at the end of the plumb line ☹

A REMARK:

This is an article of the monthly published WOLF'S PLUMB BOB NEWS that is sent on demand as PDF-file attachment by email. FREE.

You can see all former and future publications on my website www.plumbbobcollectors.info

Remarks and contact by email:

plumbbobwolf@t-online.de

Thank you for your interest!

Wolf Ruecker

B FOOTNOTES and SOURCES

¹ WOLF'S PLUMB BOB NEWS 2009-06 THE PLUMB BOB OF WASHINGTON MONUMENT IN WASHINGTON D. C.

² On Amazon for less than \$ 20.00

³ http://de.wikipedia.org/wiki/Mount_Rushmore

⁴ http://en.wikipedia.org/wiki/Gutzon_Borglum

⁵ http://en.wikipedia.org/wiki/Gutzon_Borglum

⁶ Modern Mechanics 1933 WORLD'S LARGEST STATUE CARVED IN MOUNTAIN

⁷ <http://www.loc.gov/pictures/resource/cph.3c05079/>

⁸ http://www.nps.gov/archive/moru/visitor_services/studio.htm

⁹ From Glenn Forley:

http://www.williamcronon.net/writing/Parsons_School_Scapes_Interview_with_William_Cronon_Fall_2006.pdf

¹⁰ From Glenn Forley:

http://www.williamcronon.net/writing/Parsons_School_Scapes_Interview_with_William_Cronon_Fall_2006.pdf

¹¹ MORU 0269: Photograph by Julian Spotts, NPS Photo, 1936

¹² MORU 5210 Unknown photographer

¹³ Modern Mechanics 1938 p 825 „Models used in shaping Mt. Rushmore group”