2025 SURVEYORS' Conference

Monumental Surveyors

Surveying for Monumental Carvings at Stone Mountain, Mount Rushmore, and Crazy Horse

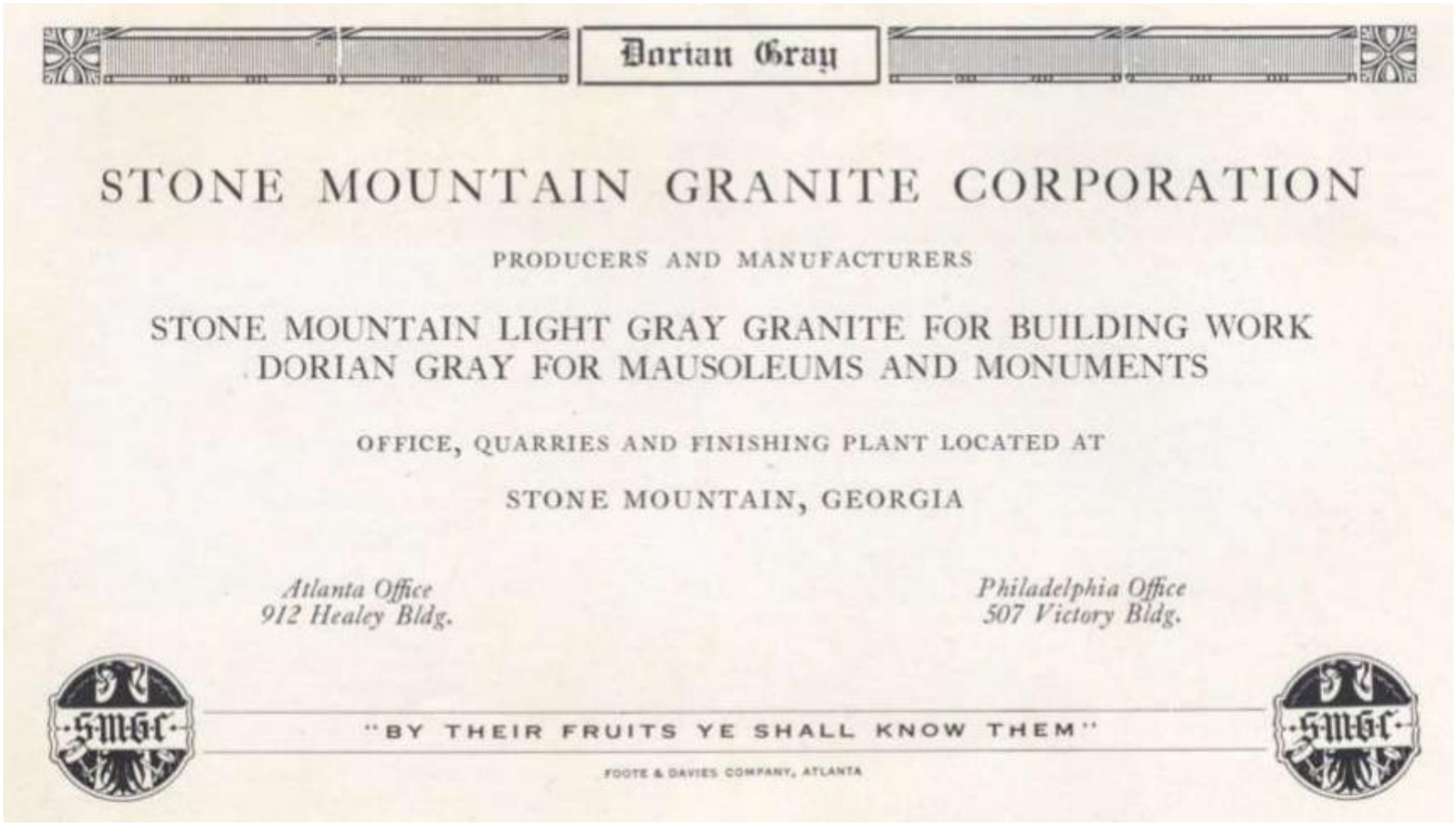
Presenter: Don Teter
Assistant Professor of Surveying
Fairmont State University

JANUARY 12-15, 2025 | HERSHEY, PA

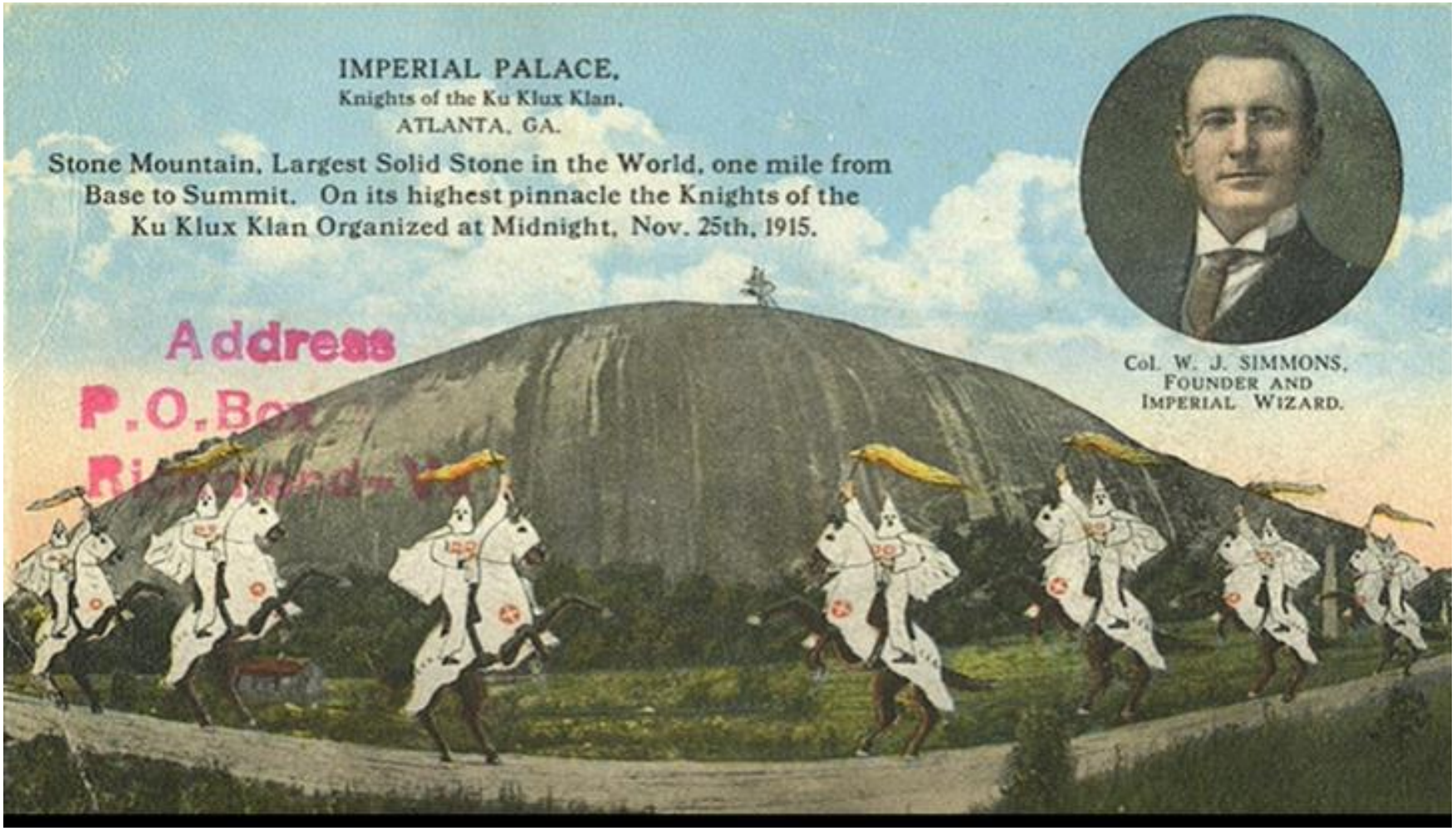
Stone Mountain

Gutzon Borglum's Debacle on a Mountain with a long and sometimes troubling history

Much of the earlier history of the mountain involved the lucrative and labor-intensive quarrying industry. Quarrying operations began in 1845. The mountain was sold to Stone Mountain Granite Corporation for $14,400 in 1867. A railway spur was added in 1869. Southern Granite Company bought the mountain in 1886.


Dorian Gray
STONE MOUNTAIN GRANITE CORPORATION
PRODUCERS AND MANUFACTURERS
STONE MOUNTAIN LIGHT GRAY GRANITE FOR BUILDING WORK
DORIAN GRAY FOR MAUSOLEUMS AND MONUMENTS
OFFICE, QUARRIES AND FINISHING PLANT LOCATED AT
STONE MOUNTAIN, GEORGIA
Atlanta Office
912 Healey Bldg.
Philadelphia Office
507 Victory Bldg.
S·M·G·C
"BY THEIR FRUITS YE SHALL KNOW THEM"
FOOTE & DAVIES COMPANY, ATLANTA
S·M·G·C

c. 1914



Screenshot from **The long history of Stone Mountain, Georgia,** Smart History, 2021

https://www.youtube.com/watch?v=Sibg4-uTIE0

Atlanta Constitution
November 28, 1915
https://commons.wikimedia.org/wiki/File:19151128AC_Klan_re-established.jpg

KLAN IS ESTABLISHED WITH IMPRESSIVENESS

Impressive services of the past week were those conducted on the night of Thanksgiving at the top of Stone Mountain.

The exercises were held by fifteen klansmen who gathered at the behest of their chieftian, W. J. Simmons, and marked the foundation of the invisible empire, Knights of the Ku Klux Klan.

The new secret organization is founded with a view to taking an active part in the betterment of mankind, according to the statement of its members who are known as Klansmen, and the mottor is "Silba Sed Anthar."

The rites incident to the founding of the order were most interesting and the occasion will be remembered long by the participants.

Confederate Heroes in Granite

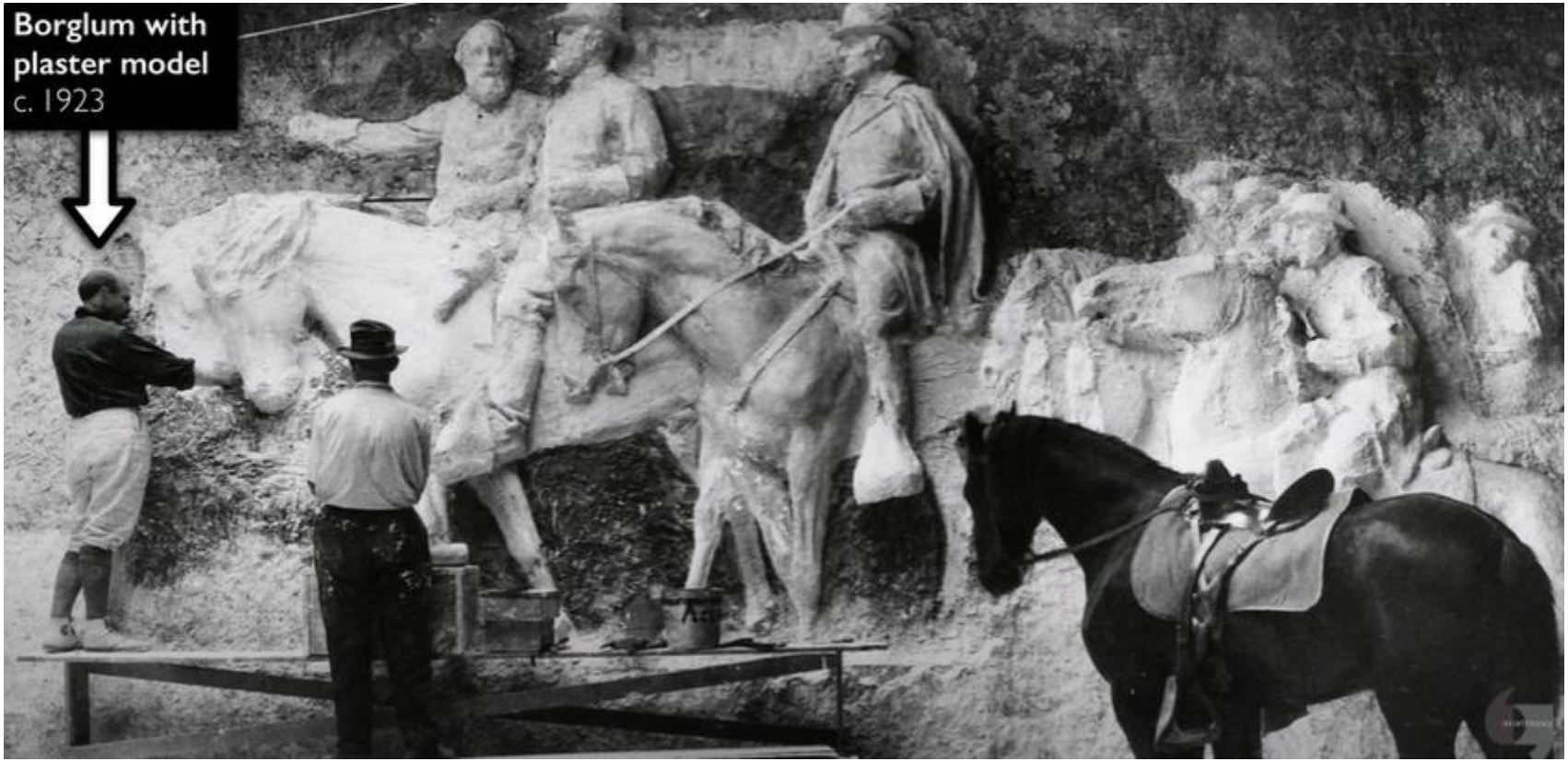
Planning for this project originally sponsored by the United Daughters of the Confederacy had begun before World War One, but work was not begun until 1922. In many ways, Gutzon Borglum's eventually unsuccessful efforts there were a dress rehearsal for his later triumphs at Mount Rushmore.

Rex Alan Smith, ***The Carving of Mount Rushmore****), pp. 64-76.*

In 1916 the Stone Mountain Confederate Monument Association was incorporated with Helen Plane as founder and first president. Granite company owner Sam Venable gave a lease until 1928.

Screenshot from **The long history of Stone Mountain, Georgia,** Smart History, 2021

Renowned Sculptor Gutzon Borglum Creates Design



Screenshot from **The long history of Stone Mountain, Georgia,** Smart History, 2021

Borglum didn't like the lighting of the originally intended location

Figure 1.
Stone Mountain showing the surface in sunlight. The dark square, 200 feet more or less, indicates the location of present work. The new design will occupy the irregular elongated space to the left marked "new location." Its length is about 1500 feet, height about 350 feet. Shading indicates perpetual shade—unsuited for sculpture.

Borglum's sketches and descriptions of his work are from:
Gutzon Borglum, *"Engineering Problems To Be Met In Mountain Sculpture,"* **The Black Hills Engineer**, Vol. 18, No. 4 (Rapid City: South Dakota School of Mines, November, 1930), pp. 309-10.

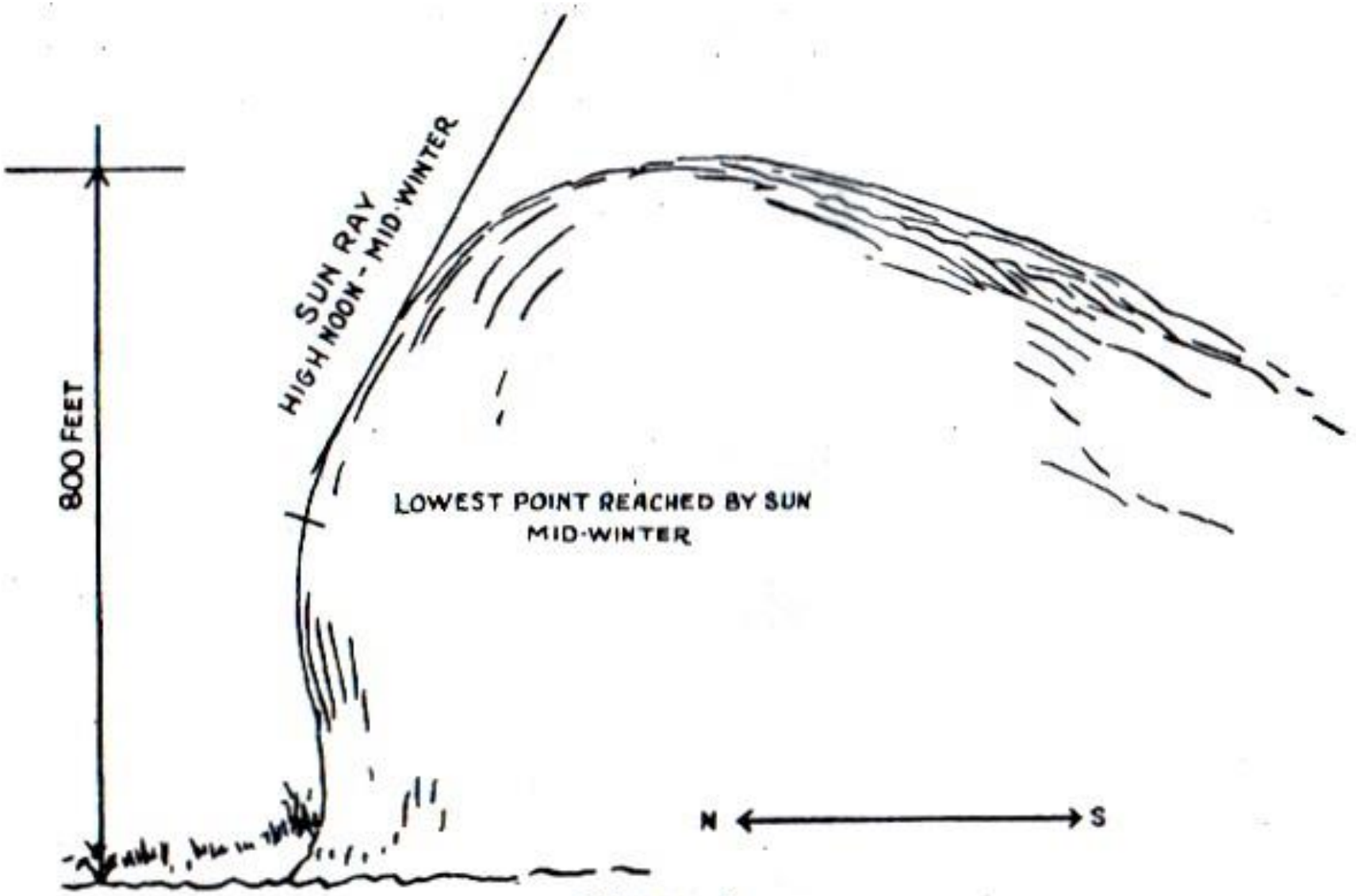


Figure 2.
Stone Mountain looking east. Shows position of light rays from the sun during mid-winter.

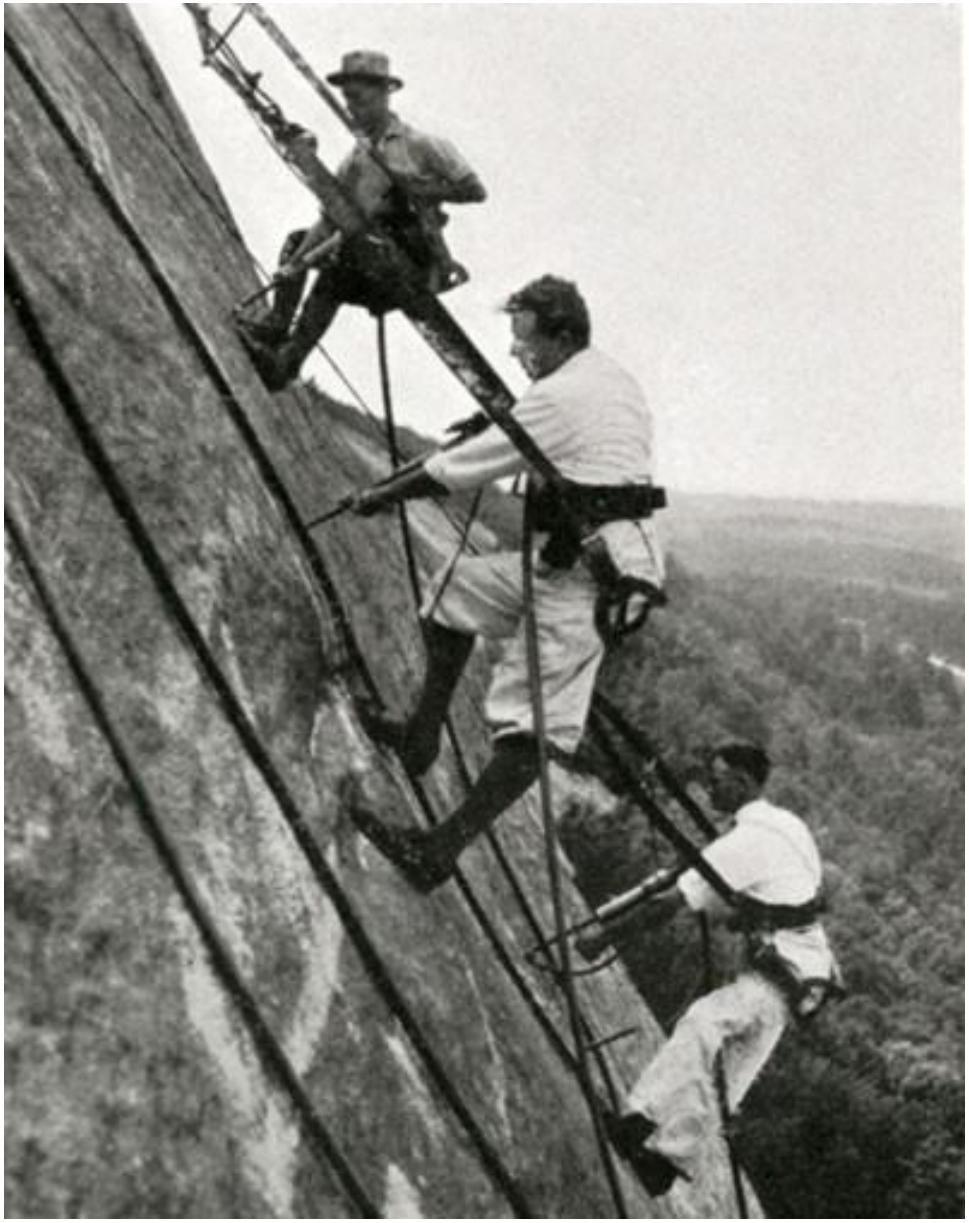
Tackling the Project

Borglum tried to paint his design on the mountain:

"The stone being a dark, brownish gray, I used white paint. … I climbed into a leather swing seat I had adopted, … made of heavy leather—a steel leather-covered seat, to which was attached four hundred feet of flexible cable, and ordered the man at the winch to lower me over the side … I hung there like a human plumb bob, my feet in rubber sneakers, my knees padded with hemp sacks, …a small copy of my design to scale in my pocket. I had … laid out the first 200 square feet, … into 50 foot squares and applied this in scale to my design. I drew on the mountain side … the head and shoulders of Lee and the upper curve of the neck of his horse; the horse's head, then down over the shoulder, down his chest to his fore leg, on to his knee. This knee was as large as a Ford car"

Borglum's illustrations and descriptions of his work are from:
Gutzon Borglum, *"Engineering Problems To Be Met In Mountain Sculpture,"* **The Black Hills Engineer**, Vol. 18, No. 4 (Rapid City: South Dakota School of Mines, November, 1930), pp. 309-10.

“I could not reach the outer lines without shifting my position. … my cable caught on a small nubbin of granite two hundred feet up, then slipped. As I dropped to take up the slack … my foot slipped. I spun around in my seat, struck my head, spilled my paint. … From below it was said I looked like a horse fly making a tail spin. I recovered my position and called to be drawn up. Tired, exhausted, mad, I descended to the valley below, where we view the work and judge of what we have done. I could hardly find it, but worse than that, it was unsatisfactory. I was frankly in despair. … by some process, I must increase my own efficiency. I must be able to place my design on the mountain, without the frightful physical and nervous exhaustion I had experienced in two hours or I would perish before I had even properly drawn the work.”



Stone Mountain drilling crew similarly suspended as Borglum's rig

https://stonemountainguide.com/Carving-History-Photos.html

The Projection System

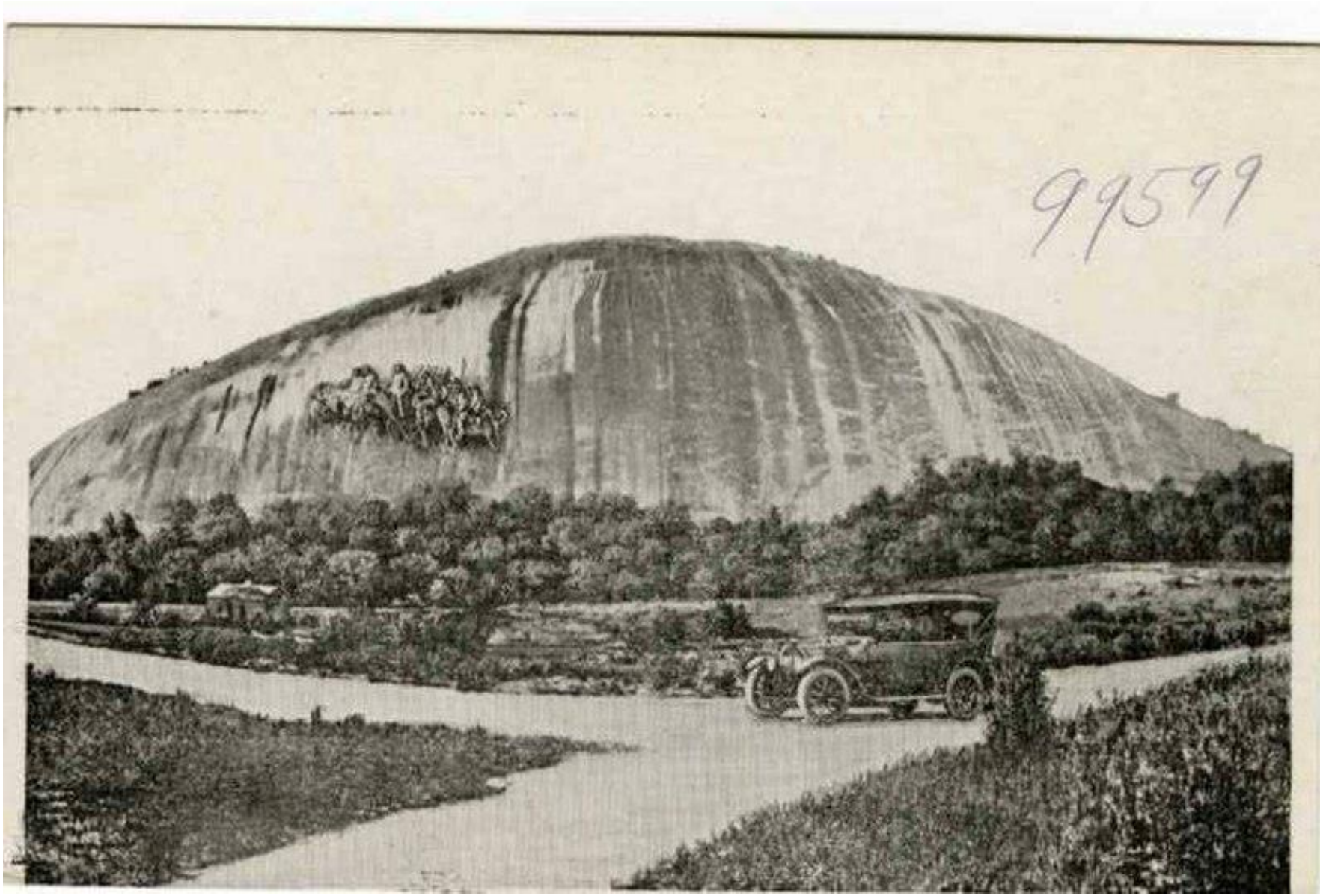
Borglum wanted a lamp and lens to cast an image

"at least a thousand feet; … Of the lamp makers I asked a ray powerful enough … All, without exception, wrote me at length 'the feat was impossible.' 'Up to date no lens would stand the heat, much less a slide' and no image or design could be projected more than 250 to 270 feet, with sufficient sharpness in design to be read!"

"… he was told by exerts at Eastman Kodak and other companies that it was impossible. … the brightness required … would take such a powerful lamp that it would melt any slide placed in front of it, and assured him the idea was ridiculous. However, he went to work with E.S. Porter of the Precision Machine Company of New York to build a machine in which the lamp assembly weighed a ton." *Rex Alan Smith,* ***The Carving of Mount Rushmore***

Borglum describes his success:

"… in my home in Stamford … projecting against a snow covered hill, I succeeded by aid of an amateurish collection of assembled lamp, high power lens and stereoptican. I was directing my ray at a 40 foot canvas at 700 feet, when suddenly my little six year old daughter exclaimed and told me to look at the horses and soldiers on the snow on the hill beyond, over 1500 feet away, so distinct I could have redrawn them on the snow. The experiment had been perfected … In consequence I ordered necessary parts, built lamp complete and within sixty days I showed an equestrian on Stone Mountain at 10 o'clock at night, so brilliant my young son snapped the perfected picture with a kodak camera and it was reproduced and printed in the morning press in Atlanta. This picture was projected from a two and a half inch slide about eleven hundred feet and covered an area 200 feet square -- one acre on edge."



1924 postcard: *Stone Mountain, where Confederate Men is being chiseled in Solid Granite*

Warped Images

After drawing outlines on the slides so his workmen could tell what to mark on the stone, Borglum's crew managed to sketch the heads of Lee and Jackson on the mountain side, but then another problem became evident. Borglum described the difficulties of distortion:

"In the morning we examined our work. I had expected distortion, but on going back twenty-five hundred feet from the mountain, it would be difficult to express my amazement to find the problem of distortion our drawing showed … The bottom of the picture seemed fairly accurate but two hundred feet higher Lee's head and his body began to lengthen; his face was longer and the top of the soft hat was much taller than the old fashioned silk or stove-pipe hat."

Reversing Distortion

"… the distortion increases … as we near the top of the ray… Finally it crossed my mind … that if I could tip the mountain over so as to place its surface at right angles … I would get approximately a true picture, or if I built a tower four hundred feet high I could project a fairly accurate picture. … the thought of tipping the mountain suggested the idea of tipping the model and tipping it as much further toward the camera as the mountain receded the other way. … These thoughts then suggested another, … to make a new true picture of the model, center it carefully and photograph it from a calculated distance above the center of the lens, tip the photo forward and down and so produce a reversely distorted picture. This … is the most perfect way of overcoming that particular distortion in the design, but for our purpose, … for general location, another thought came to me, to make the slide holder on hinges and tip the slide. … this became our working method."

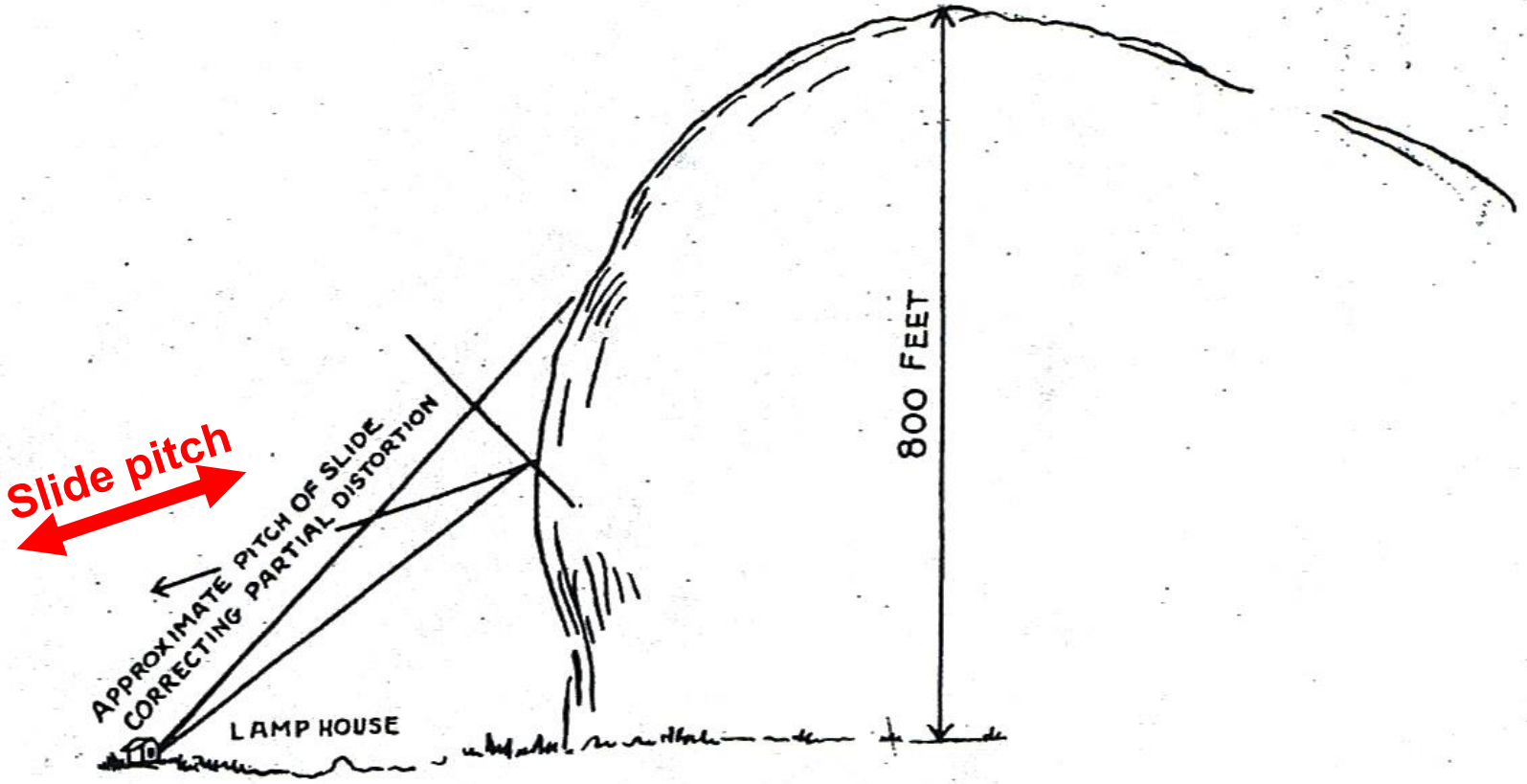


Figure 3.

Stone Mountain showing action of light rays thrown upon its surface from lamp house approximately 500 feet from the mountain. This ray, it will be seen, strikes the mountain side about 330 to 350 feet from the ground, the upper part of the ray striking at about 200 feet above due to the necessary acute angle of ray to mountain and also the curvature of the mountain.

Partial Success

Borglum managed to complete the head of Robert E. Lee at Stone Mountain, and it was unveiled on Lee's 117th birthday, January 19, 1924.

Smith, pp. 68-76

https://stonemountainguide.com/Carving-History-Photos.html

Borglum's luncheon on Lee's shoulder. Gutzon Borglum is at the left and his son, Lincoln, is at the upper right.

Borglum Loses Stone Mountain

Money problems and disagreements over how to proceed soon arose, and by early in 1925 Borglum was off the project. Another sculptor took over, and eventually butchered Borglum's carving of Lee so thoroughly that it was completely blasted off the mountain, and by 1928 the project was dead.

Smith, pp. 68-76

Reportedly Borglum smashed his models and left in March 1925, and the law was sent to arrest him for destruction of the property of the Monument Association, but he beat them to the state line.

This 1924 photo shows how Borglum left the carving.

https://stonemountainguide.com/Carving-History-Photos.html

Augustus Lukeman

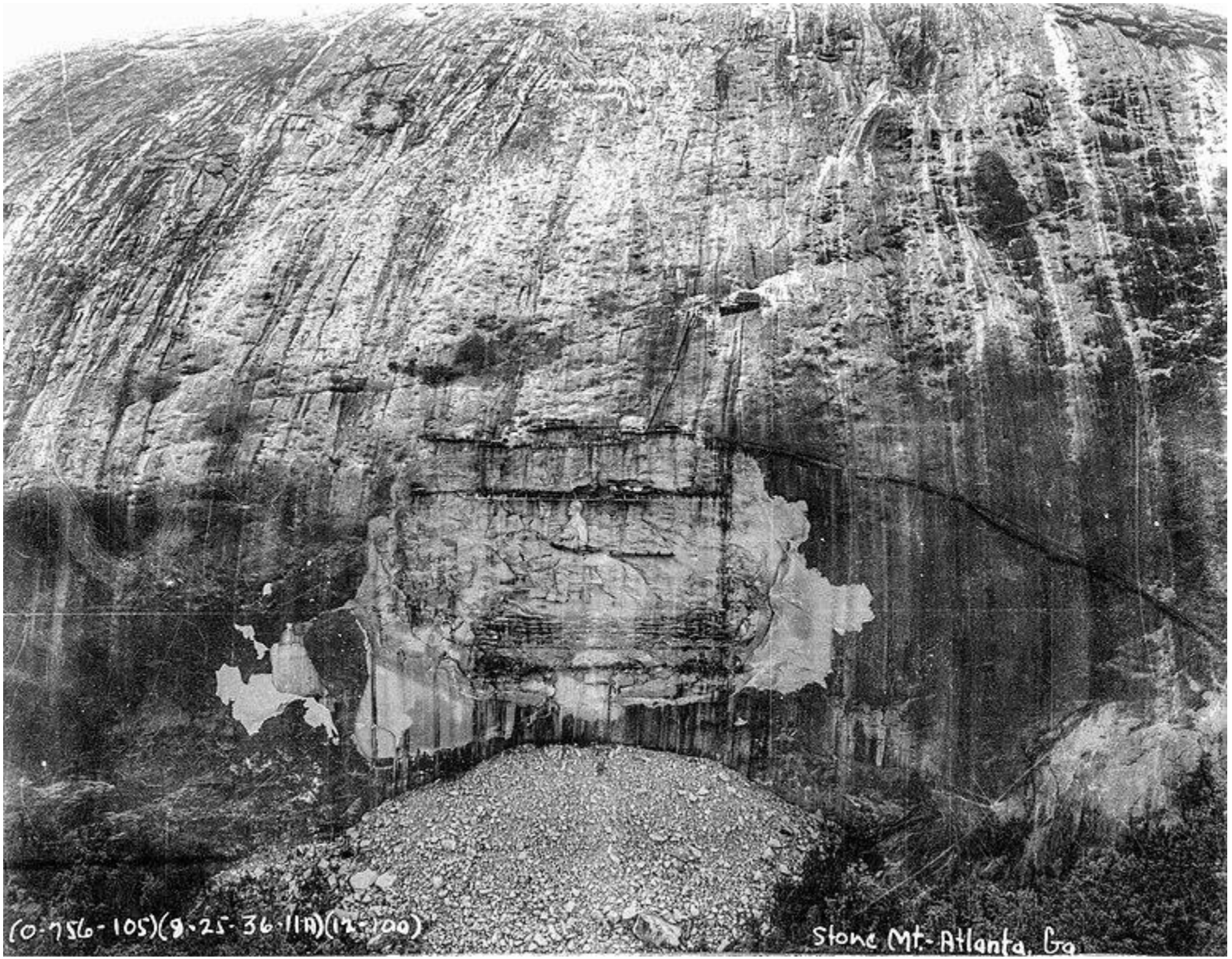
"No sign of Borglum's work remains at Stone Mountain. However, he made a vital contribution. It is doubtful if any other artist would have had the imagination to visualize such a stupendous monument in such an inaccessible place, or have had the nerve to start carving it."

Augustus Lukeman took over the project in 1925, and made a new design, but only:

" … blocked out the figures of Lee and Davis and finished their faces and also roughly outlined Lee's horse, Traveler before the deadline of March 20, 1928. It was evident that he was capable of completing the monument. …"

On May 20, 1928, the Venables reclaimed their property, ending the UDC's chance to complete the memorial.

Willard Neal, **Georgia's Stone Mountain** undated, sold at Stone Mountain in 2010



The 105th Observation Squadron aerial image of the Stone Mountain carving in 1936.

Previous image zoomed in on Lukeman's work

Finishing the Project

"In 1958 the Georgia Legislature … named a Stone Mountain Memorial Association, with authority to purchase the mountain and surrounding land, 3,200 acres in all, for a state park, and to complete a satisfactory Confederate monument."

… The Association approved a suggestion by Walker Kirtland Hancock for making Lukeman's uncompleted design appear intentional by carrying the carving to a point that would be aesthetically satisfying …

Mr. Hancock was engaged in 1963, and charged with responsibility for finishing the design according to his plan, for serving as a direct consultant for the carving, and for developing the memorial area."

Willard Neal, **Georgia's Stone Mountain**

Finishing the Project

… The foreman of the working crew, Roy Faulkner … experimented with the new carving tool to be used, and discovered he had a knack for it. Although the foreman had never had an art lesson … he was assigned some smoothing tasks by sculptor Hancock while the search continued for an experienced carver. Soon the search was forgotten. Roy Faulkner stayed on the face of the mountain for more than six years … the new tool was the thermo-jet torch, developed for use in granite quarries. One hose carried kerosene, another oxygen, and the third water to be sprayed through the jet nozzle to keep it cool. The operator could adjust the flame to any temperature up to 4,000 degrees.

… [it] could remove several tons of stone in a day, more than 48 men could do in a week with drills and wedges. Carving with it was a one-man job. Two men trying to work in the same area would have bombarded each other with hot rocks. … Exploding flakes popped out in many directions, sometimes straight back, or ricocheting off the mountain or steel cables … the roar of the torch … was the dominant sound in the north end of the Park for six years.

Willard Neal, **Georgia's Stone Mountain**

Finishing the Project

The torch acted like a miniature jet engine, developing about as much backward thrust as an automatic shotgun. The carver had to keep his body braced against this force as long as the flame was lit.

… Fine carving was done with a tool half as large. With the flame adjusted as thin as an acetylene torch's, it could cut along a pencil mark.

… In explaining how he carved, Faulkner said that mostly he measured. If he was to start a new feature, like the knuckle of General Lee's first finger, he measured the distance to it from his center line on the master model. Then he checked to get the distance to the knuckle from Lee's ear, his nose, Davis' eye, the ear tips of the horses, and other spots. Interpolating inches on the model to feet for the mountainside, he measured from corresponding points on the carving. When all the measurements came out at the same place, he drilled a hole there to the exact depth corresponding to the distance from the knuckle to the plumb line at the front of the model. To insure against cutting away too much of the adjoining stone, he measured and drilled depth holes for all of the features nearby.

Willard Neal, **Georgia's Stone Mountain**

Finishing the Project

… There were special models of the heads of men and horses, on a scale of four-to-one. When working on a head Faulkner took the corresponding model up on the scaffold for ready and frequent references.

… Faulkner declared … 'For six years I worried that I might make a mistake. After coming down in the evenings I checked the day's figures in the studio to make sure they were right. Then I drove home with them in my head, ate with them, and often slept with them. The worst dream I ever had was the time I saw General Lee's head lying in the ditch at the base of the mountain."

Willard Neal, **Georgia's Stone Mountain**

Mock-up in Visitor's Center

Stone Mountain Today

From the Summit Skyride

Mount Rushmore

Construction Surveying

Surrounded by Awesome Scenery

Lincoln Borglum quotes are from:

Mount Rushmore: The Story Behind the Scenery, 1993, KC Publications

Timeline of the Mountain

October 1, 1925, Dedication

October 4, 1927, Drilling started

July 4, 1930, Rough likeness of Washington unveiled

August 30, 1936, Jefferson head dedicated

September 17, 1937, Lincoln head dedicated

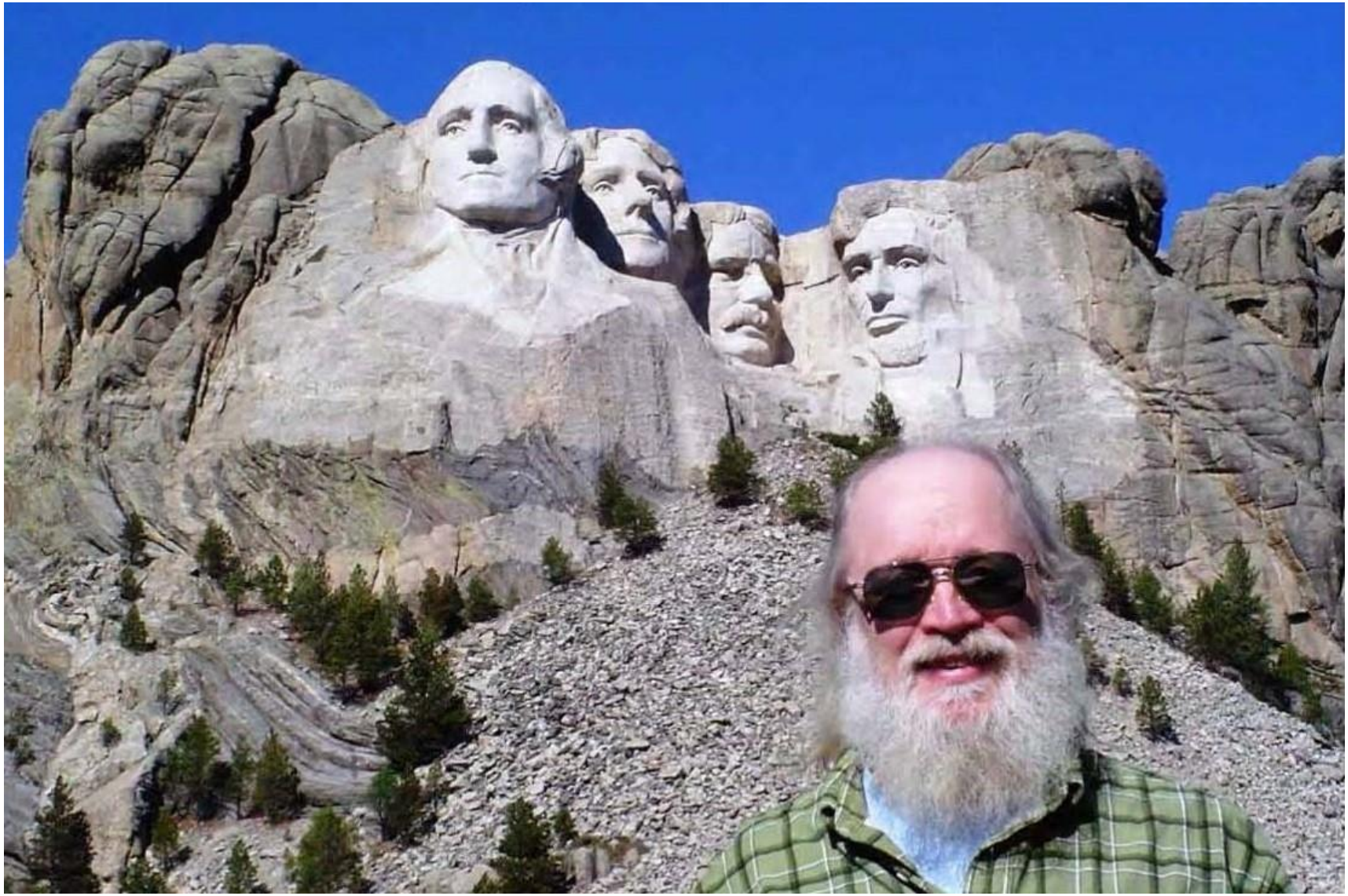
July 2, 1939, Roosevelt head dedicated

March 6, 1941, Gutzon Borglum dies, his son Lincoln takes over

October 31, 1941, carving stops

"Indeed I wonder if in my father's critical eyes it would ever have been finished"

Lincoln Borglum



Four Surveyors and One Other Guy

Borglum Gets Another Mountain

With Different Challenges

"The challenge of Stone Mountain had been great, but it had been as nothing compared to this challenge at Rushmore. There, Borglum had been carving shallow bas-relief figures on stone that was relatively smooth and unflawed. Here, he would be carving much larger figures, deep and in-the-round, on a fissured crag containing heaven only knew what kinds of defects. …

"Projection would work for flat figures but not for those to be carved in-the-round. Besides, Rushmore's face was too lumpy for accurate projection. It would have been like trying to project a picture onto the side of a sack of potatoes."

Smith, pp. 157-159.

The untouched mountain

https://primalnebula.com/how-mount-rushmore-was-carved/

Measurements to the Mountain

"… The safest way … would have been … to peel off the entire surface of the area he intended to carve, remove … unsound rock … , and then reshape the cliff to fit his models. It would have been a sensible thing to do … His artistic integrity would not permit it …

He chose to carve one head at a time, and not to locate the next one until he could see how it would blend with the previous work as well as with the mountain itself …

Having decided to make Washington the monument's dominant figure, Borglum decided to begin with the Washington head and to place it on the highest and front-most dome of the cliff's irregular crest."

Smith, pp. 157-159.

From the Model to the Mountain

Gutzon Borglum created rough models, saying "Finished models should not be made – in them all the creative impulse has expressed itself; the enlargement is inevitably a stillborn, dead, soul-less thing."

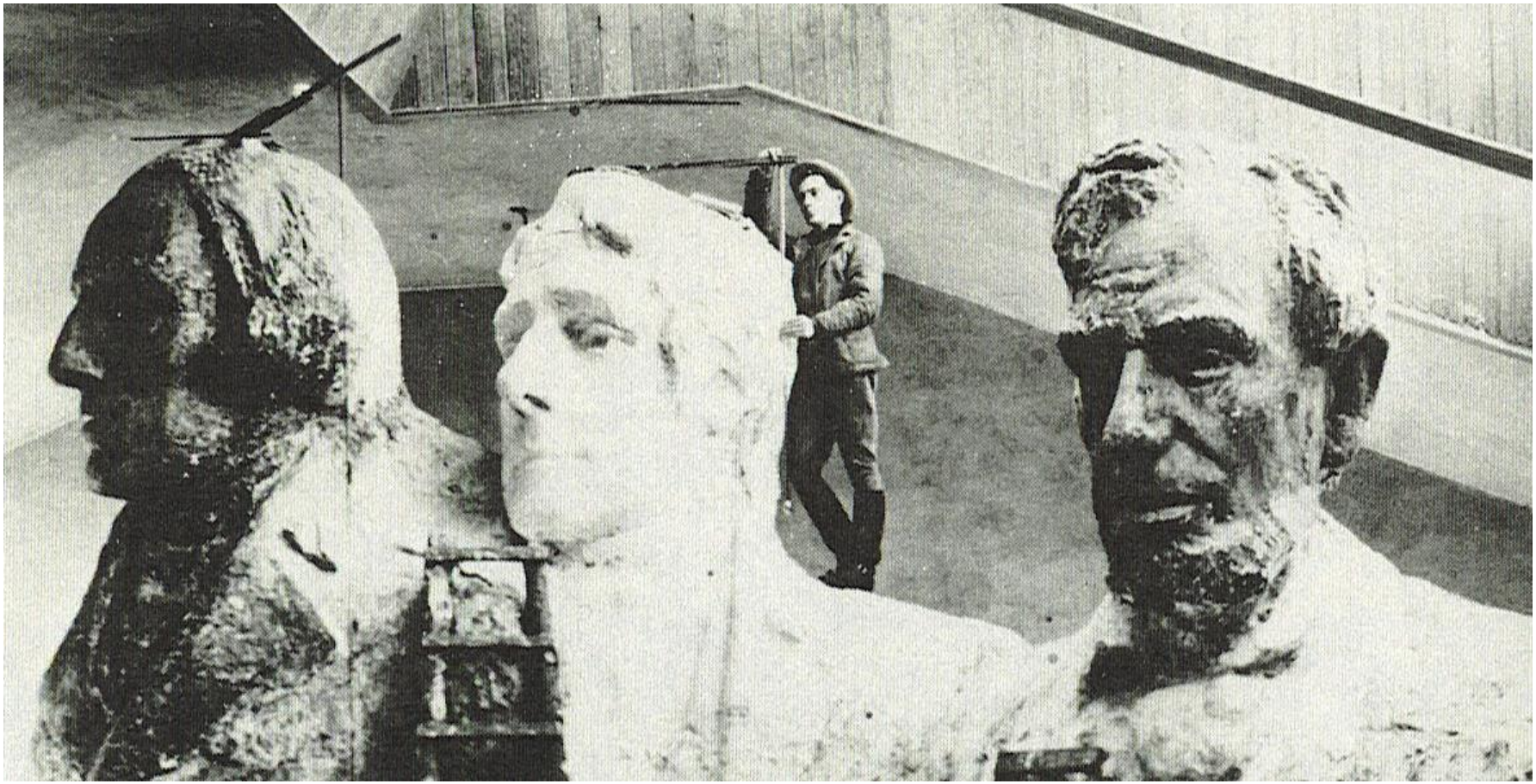
Lincoln Borglum

From the Model to the Mountain

Measurements had to be transferred from the rough models to the mountain where Washington's face would be "60 feet long; nose, 20 feet long; eyes, 11 feet wide; eye projections, 22 inches. Roosevelt's mustache would be 20 feet long, and Lincoln's mole 16 inches across."

Lincoln Borglum

Pointing System



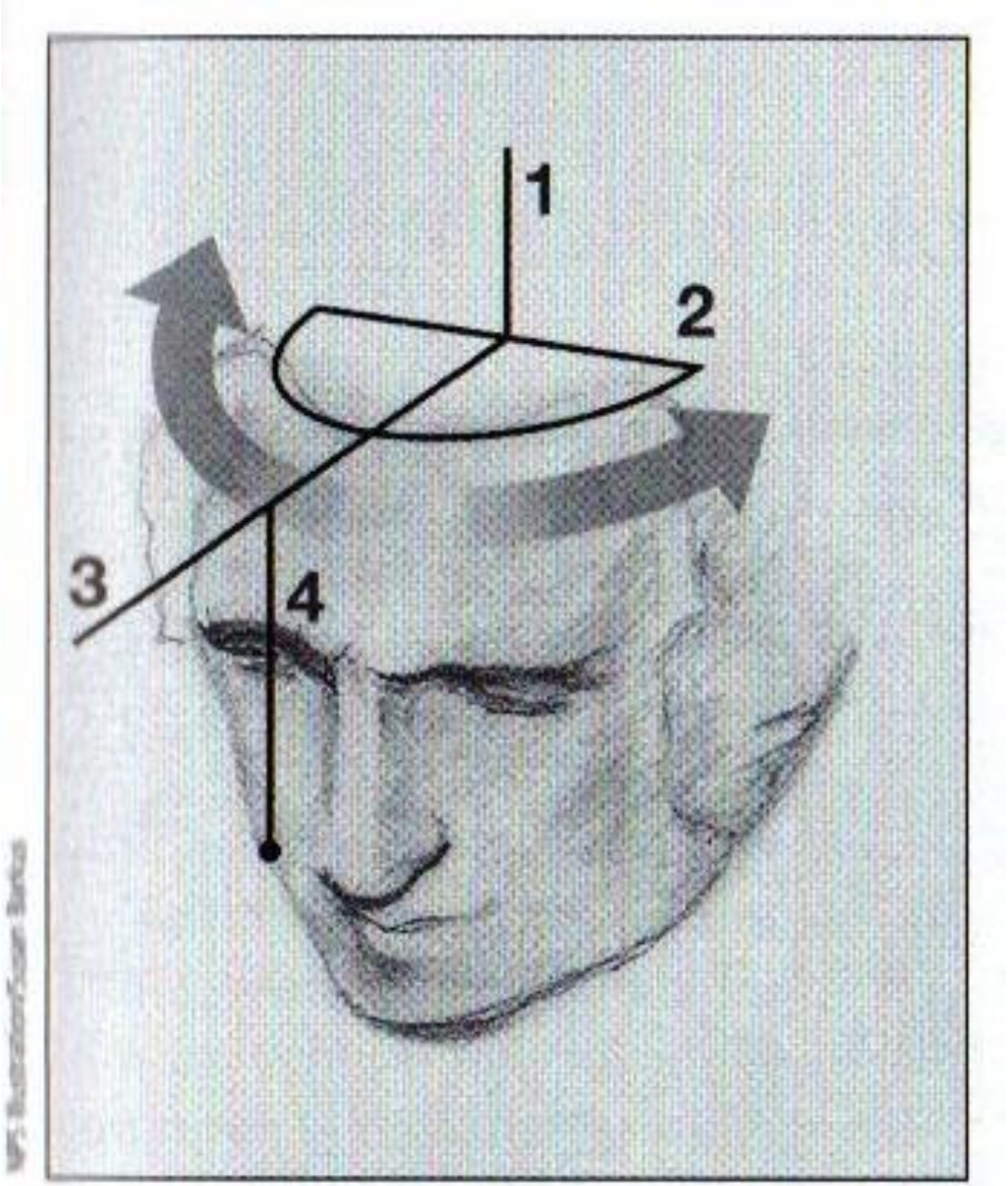
Lincoln Borglum taking measurements
from the 1/12 scale models

“Pointing Machine”

“sculpt-by-numbers”

“At the top and center point of the mass which was to be the head, an upright cylindrical shaft was placed, mounted on a base of steel bolted to the mountain – a plate about four feet across its flat surface, upon which was cut the 360 degrees of a circle (sometimes only half a circle). The shaft was held in place by guy cables stiffened with (turn)buckles. To this upright shaft a steel beam about 30 feet long was horizontally attached, in a manner much like the spoke in a wheel. This was a movable boom that could be rotated and set on any degree, and was itself divided into measurements.”

Lincoln Borglum



Pointer System

1 - Metal shaft

2 – Protractor plate

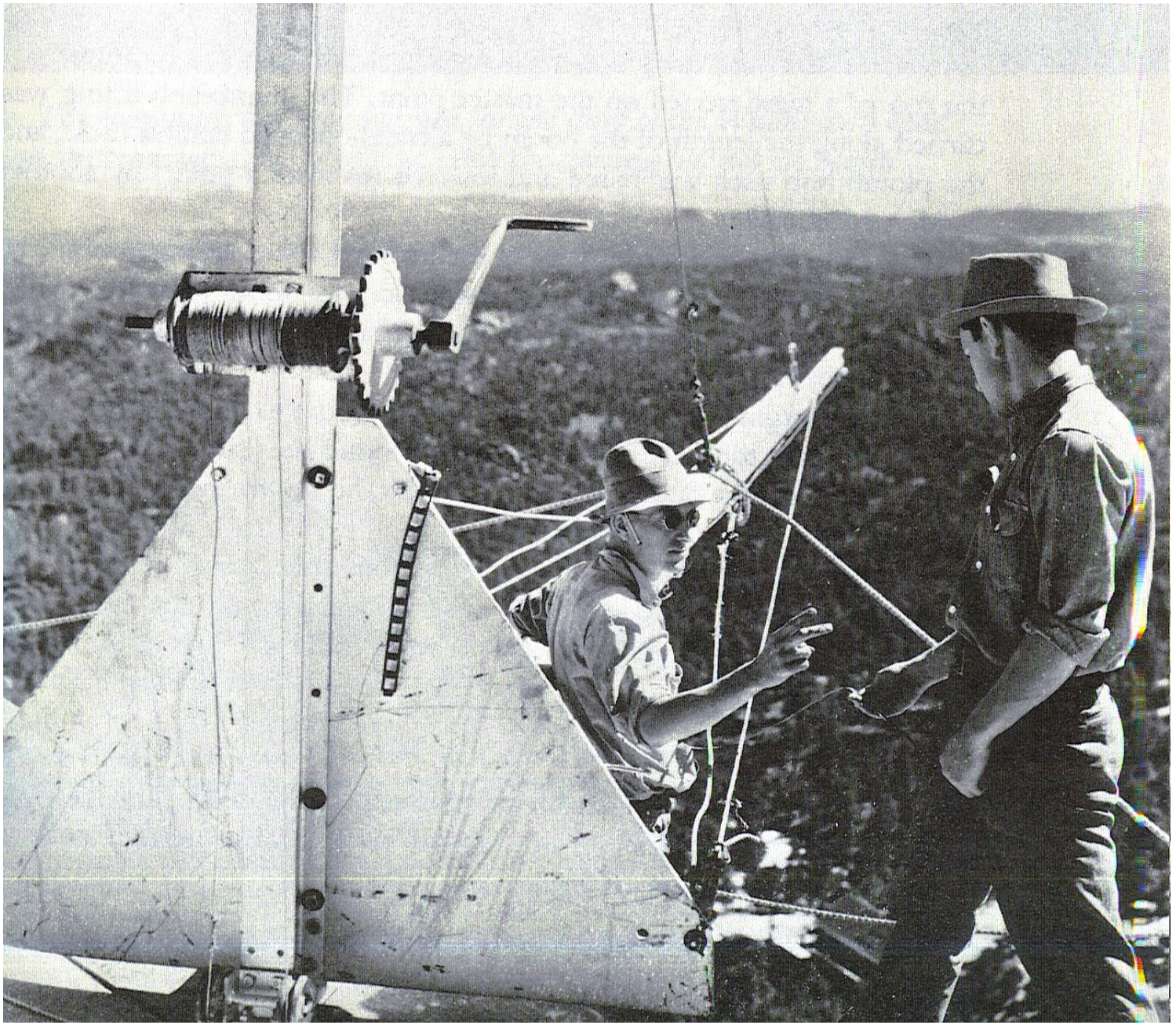
3- Ruled bar

4- Plumb line

Pointing

"From the boom hung two mercury filled plumb bobs about two feet apart, and above them a six-foot carpenter's level was mounted horizontally on the boom, since it was very important that it be exactly level at all times. Each of the plumb bobs was immersed in a bucket of oil to hold it steady, and all was suspended on sttel piano wire as fine as possible so as to have the least possible wind resistance. (Critical measurements were done early in the morning, before the wind began to blow.) This wire also was marked with measurements; it could be cranked out to any desired length by means of a device, similar to a fishing reel, mounted on the boom."

Lincoln Borglum



Pointing

"A similar steel plate and boom were installed in the same relative position on each model head in the studio below.

Measurements were made on the model and enlarged 12 times as they were transferred to the surface of the mountain. …

The finding of a hidden point, say under the nose, was done by a system of references from the known and marked points."

Lincoln Borglum

Pointing

"Accurate measurements could now be taken, rough 'points' determined, and an approximation made of the mass necessary for the carving of each head. When the excess stone was removed, a great egg-shaped mass (from three to six feet larger than the final head) would be the result. At this stage, work was halted so my father could observe over a long period of time the effects of light and shadow – the probable sunlight the head would receive – and thus determine the angle it should actually face. Such experiments resulted in the turning of the head of Washington about twenty degrees further to the south than originally intended … "

Lincoln Borglum

Pointing
(on Washington)

"With the establishment of the centerline of the face, down over the forehead beginning at the point of the wig and down midway between the eyebrows, down over the center of the nose, mouth, and chin, we were ready to map the stone for accurate drilling and careful blasting.

The first step in the pointing was to locate the point of the nose, it being the extreme projection on the face. When, using our system of transferring measurements from model to mountain, we had located the approximate end of the nose, we might find perhaps six feet or so too much stone. We made a red dot, drew a circle around the dot and painted on the side of the circle 'No. 1, 6 feet."

Lincoln Borglum

Pointing
(on Washington)

"The next points to be taken were the ones on each of the frontal bones, for which the great boom had to be swung to the right and left. Here the absolute necessity for great precision in the mechanism by which we obtained our measurements can be appreciated. Any slight twist or bend in the boom, if not detected and corrected, would result in a distortion in the face itself. We were extremely vigilant to see that such an error did not occur."

Lincoln Borglum

The "Pointer"

(Sounds like a surveyor to me!)

"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. … 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 point.

At first the measurements were quite far apart – about one foot – since the stone at that stage was just being blocked out. But as we progressed toward the final surface the measurements were made much closer together, until finally they were close enough – two or three inches – and the distance between each point a straight line, not curved. Usually these contour points were made at five-degree intervals."

Lincoln Borglum

Pointer transferring measurements to
Washington's head, fall 1927.
(Smith, **The Carving of Mount Rushmore**, p. 162)

Guiding the Drilling

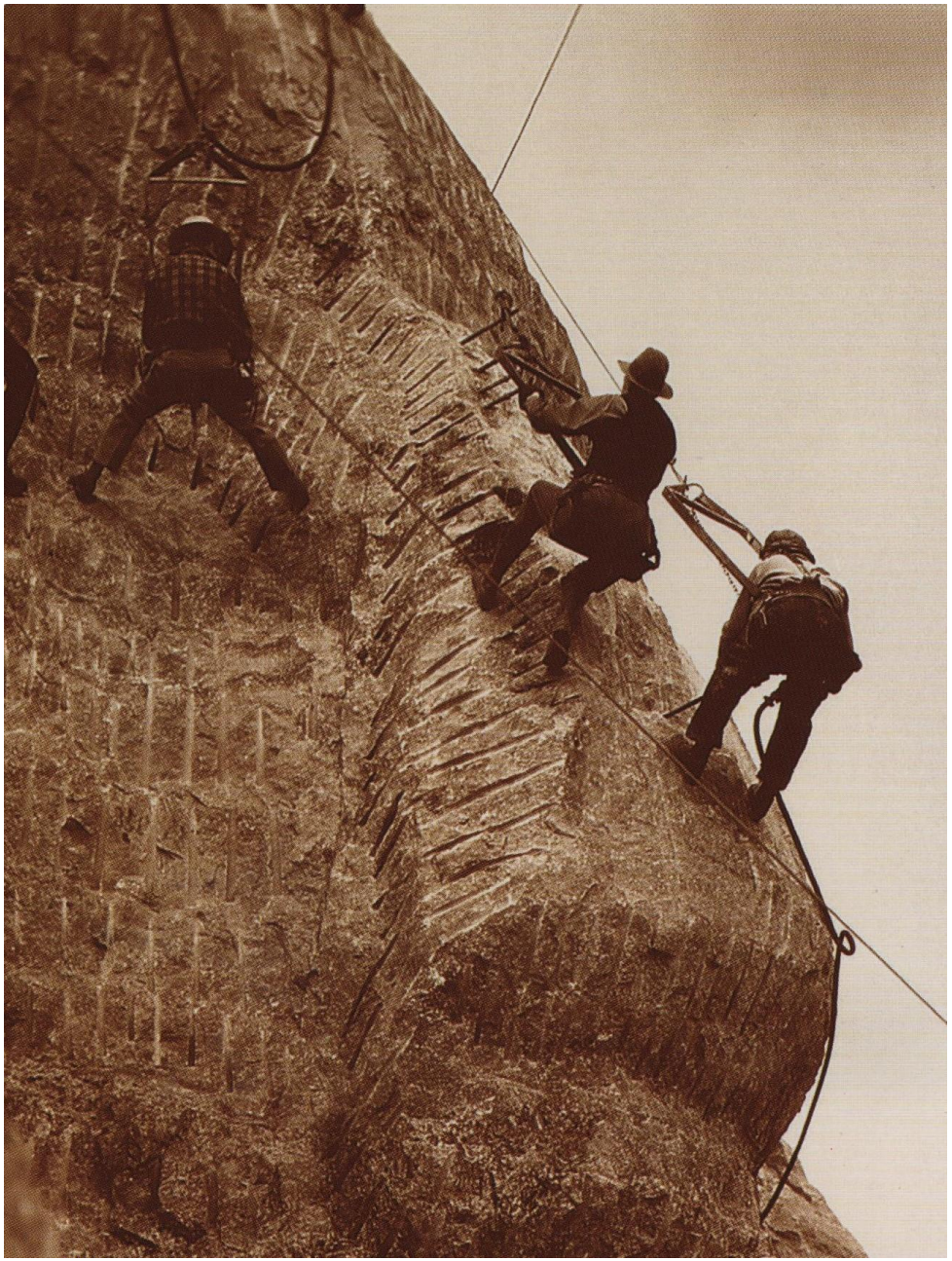
"The result was that the driller, facing a section of the mountain, would see before him, both vertically and horizontally, a series of painted marks indicating how much stone to remove at each point. He would set the series of points by drilling each to the required depth, and the surrounding stone would then be taken off to this depth.

The work was done with a margin of about three inches; this was the stone left for the actual finishing of the features and correcting of the perspective, again requiring my father's closest attention. The entire process was truly an integration of art and engineering, both of equal importance."

Lincoln Borglum

Workers in bosun chairs drilling points in the rough face of Washington

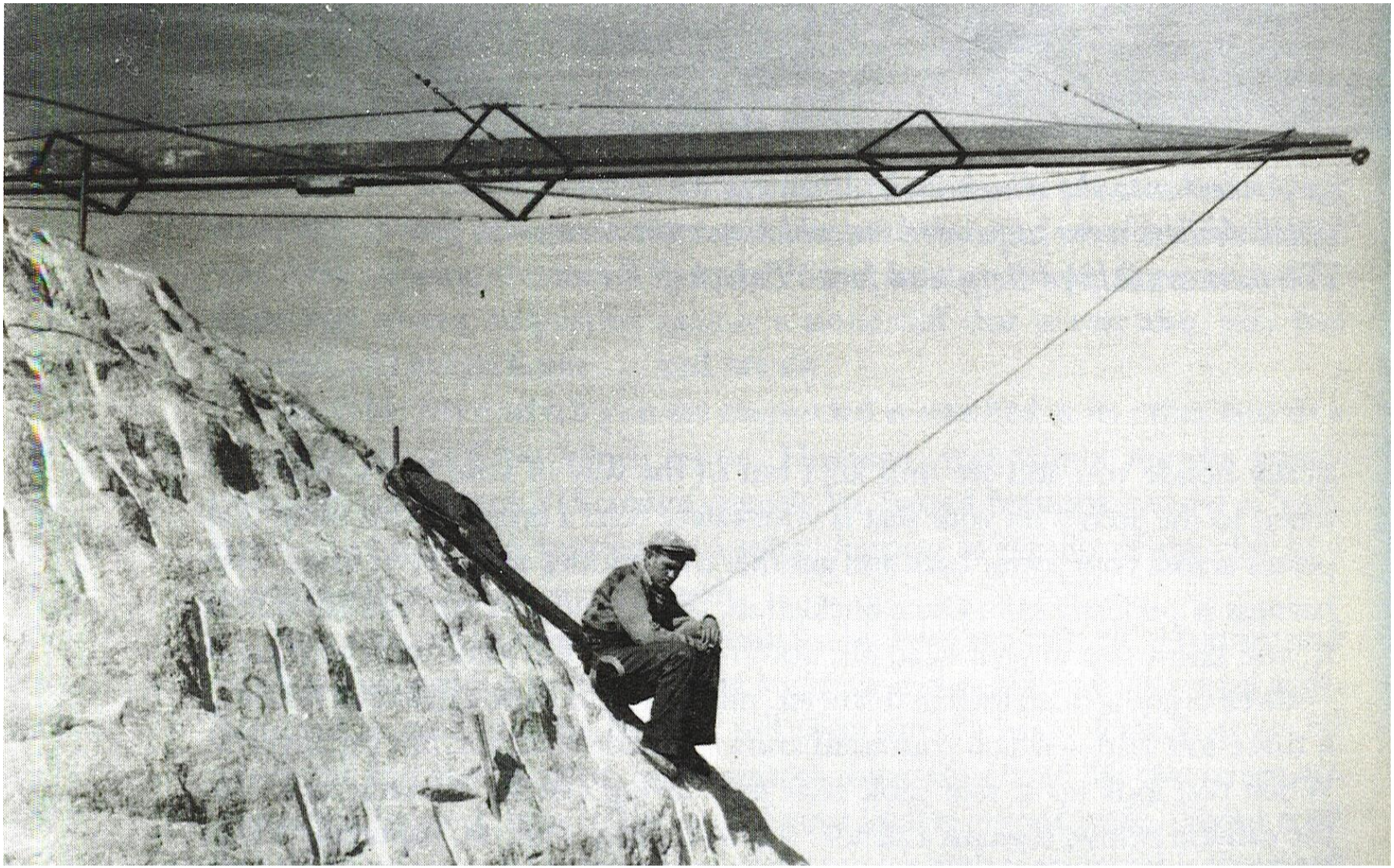
Lincoln Borglum Collection, in *Mount Rushmore: The Story Behind the Scenery*



The Callboy

"The winchmen on the top were not in a position to see the workmen in their swings. To relay instructions a 'callboy' was stationed so that he had s strategic view of the winchmen above and the workers in their harnesses below. As the noise level increased, we had to use microphones for the callboy to relay messages from the workmen as they wished to be moved over the face of the carving, to the 'steelman' (whose duty it also was to swing tools to the workmen as needed), and to the winchmen, who heard there instructions over loudspeakers."

Lincoln Borglum



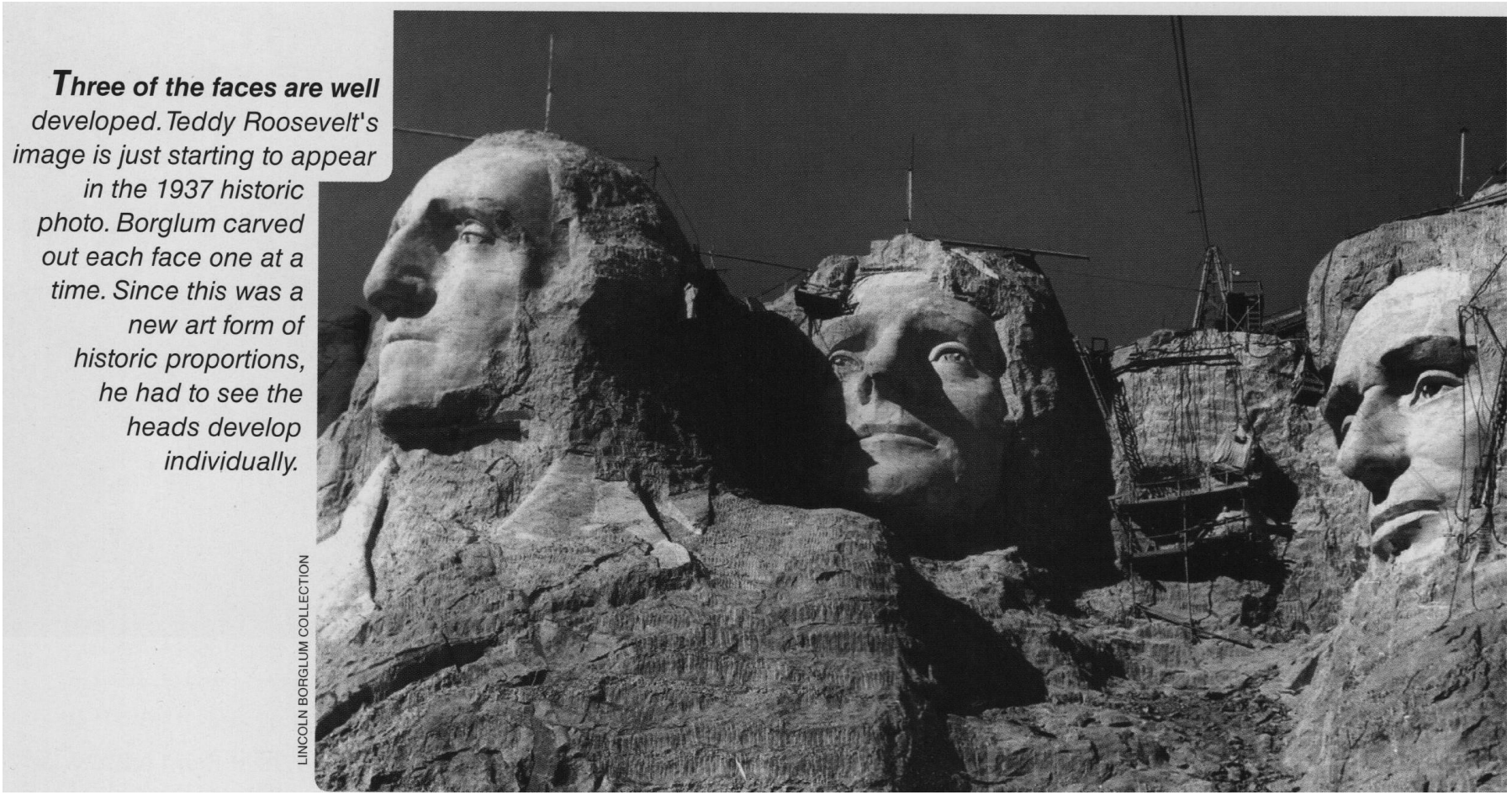
"Call-boy" Jimmy Payne, on Washington's forehead beneath the pointing boom.
(Smith, **The Carving of Mount Rushmore**, p. 24)

The Callboy

"Each harness bore a number, to increase the ease of transmitting instructions, which might simply be '6 down' or '3 hold.' Thus the workmen were free to move about over the vertical surface of the monument almost at will.

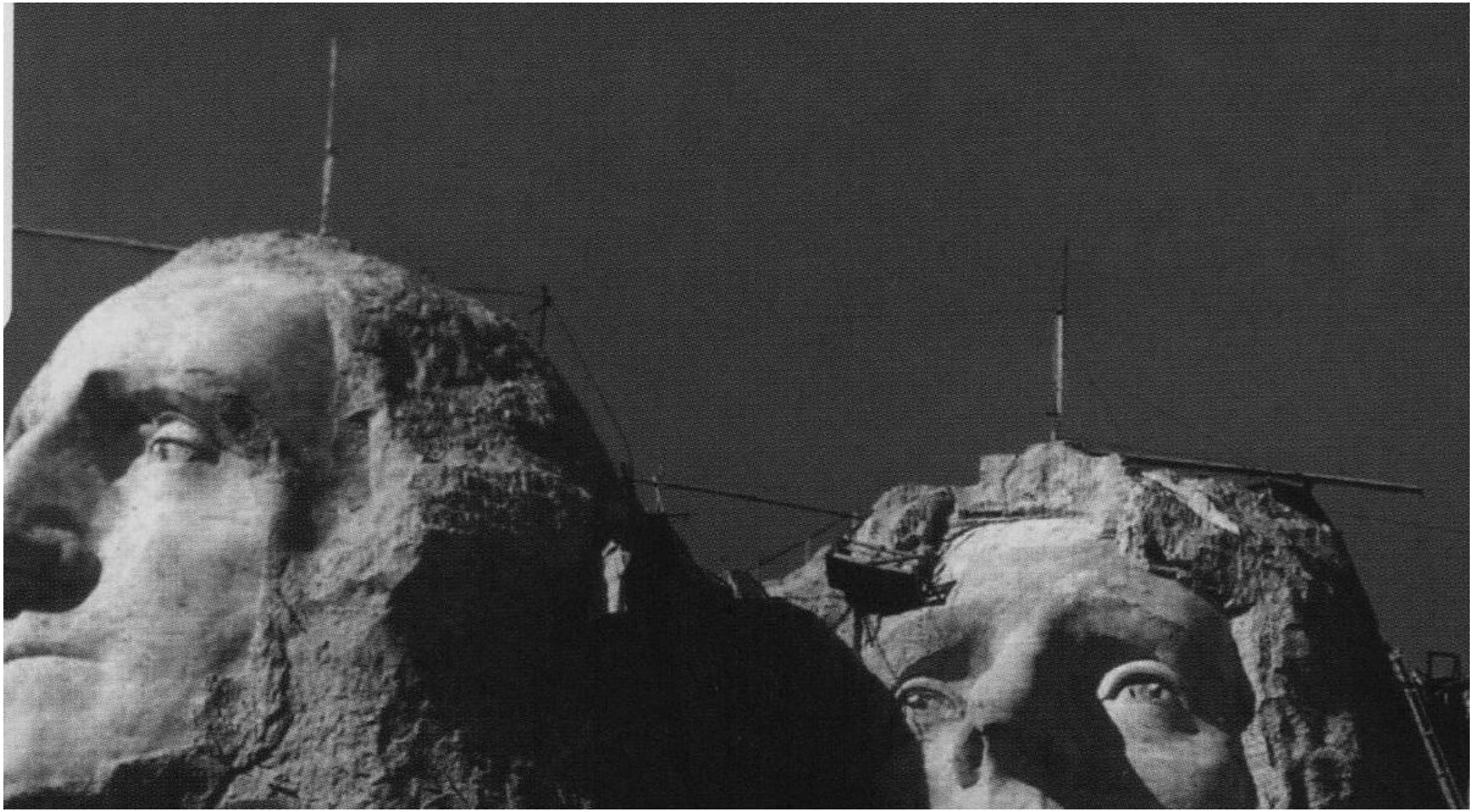
Lincoln Borglum

Pointing Machines in Place



Mount Rushmore: The Story Behind the Scenery, 1993, KC Publications

Pointing Machines in Place



Mount Rushmore: The Story Behind the Scenery, 1993, KC Publications

Blasting

"In the actual carving, the removal of over-burden was the first procedure. This was done with dynamite … (About 500,000 tons, an estimated 90 percent of the excess stone, were ultimately removed in this manner.) … had been suggested by a Belgian engineer to my father at the time he was experimenting … at Stone Mountain. There, with the aid of a powderman from Du Pont, he perfected the method … He had learned … 'two considerations to be borne constantly in mind – split off just what you want to remove and no more, and second, under no conditions so charge your load as to injure the stone left in place'"

Lincoln Borglum

Blasting

"closer to the surface we wanted to protect, holes were drilled closer together and not so deep, and the explosive charge was reduced. In the final blasting many of the holes contained no dynamite at all, and only a blasting cap was used as a charge … the drillers became so skilled in their ability to remove the right amount of stone that they could block out a nose to within an inch of the finished surface …"

Lincoln Borglum

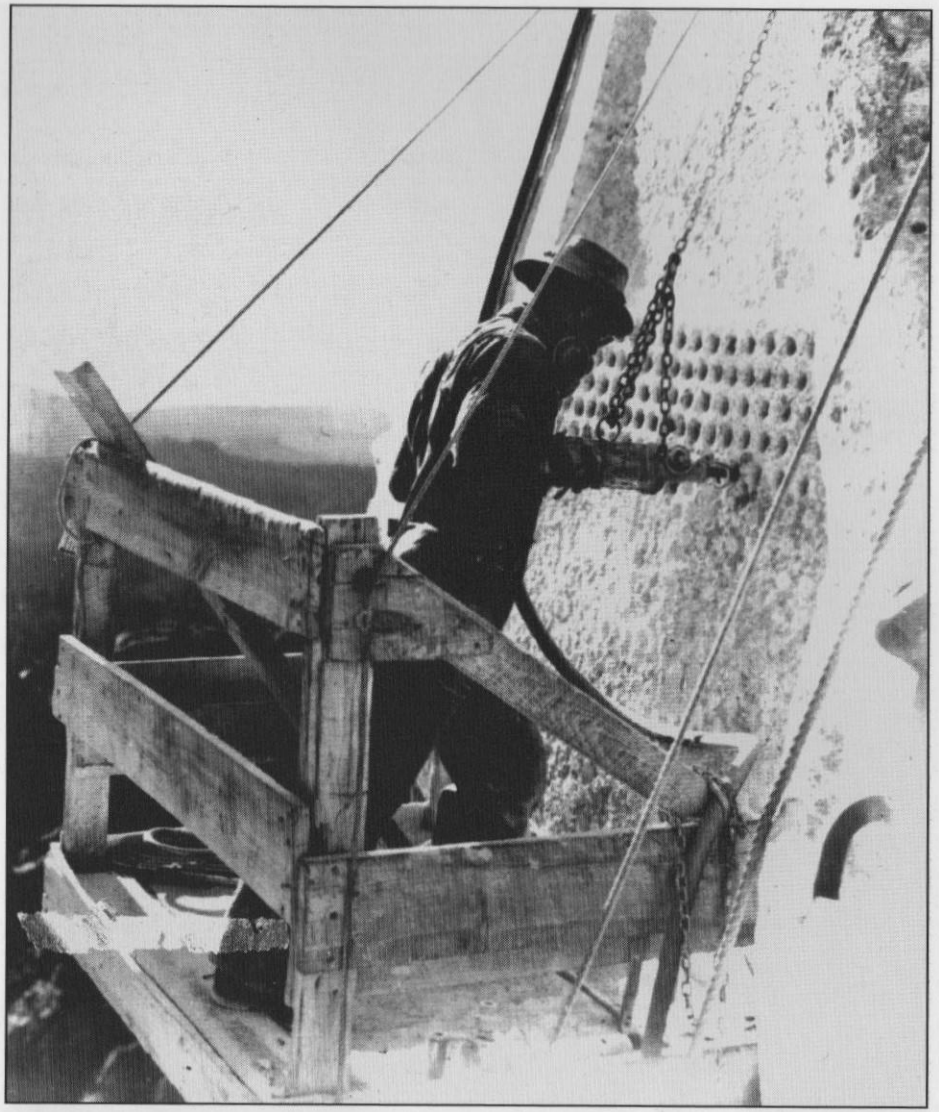
Honeycombing

"The final six or so inches of granite were taken off with pneumatic tools, mostly drilling down from the top, with holes as close together as possible, and the web between was cut out with another type of pneumatic tool, a 'channel iron.' The excess stone was then broken off with wedges and hand hammers, after which the surface was again honeycombed with drills in a series of horizontal, parallel holes, and the stone between was removed with hand chisels."

Lincoln Borglum

Honeycombing

Carver Merle Peterson, drilling honeycomb holes, is suspended in a cage by two separate winches around 1936. The last 10 percent of the rock around a presidential image was removed by this method because blasting was too unpredictable and could deface the surface rock. Holes were drilled on about three-inch centers, and a block defined on about an 18-inch square using a broaching tool that cut between the holes. The honeycomb pattern weakened the rock and a section would be pried off with a chisel and hammer. (Photograph courtesy of Robert E. Hayes.)



Tom Domek and Robert E. Hayes, **Mount Rushmore and Keystone**, 2006, Arcadia Publishing, p. 73

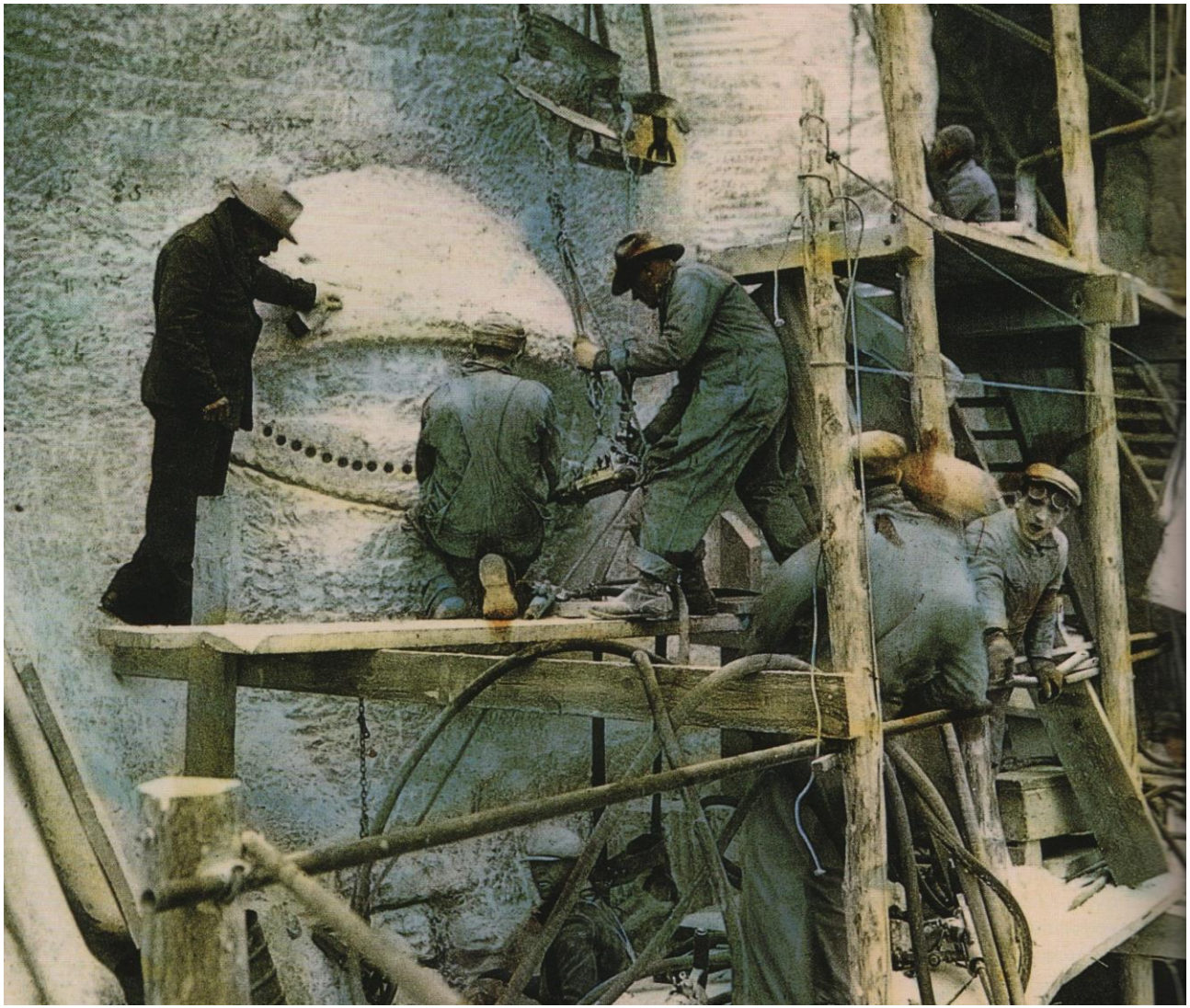
Bumping

"The final surface was obtained with a pneumatic 'bumper,' similar to a jackhammer, that bounced over the surface, leaving a texture comparable to a cement sidewalk. Most of the final design was made with this tool, emphasizing or softening features of the figures as the design required."

Lincoln Borglum

Bringing The Eyes To Life

Borglum supervises drilling on Jefferson's left eye. Chains support jackhammers for safety. Nobody died on the project, though at least one man later died of silicosis from the dust.



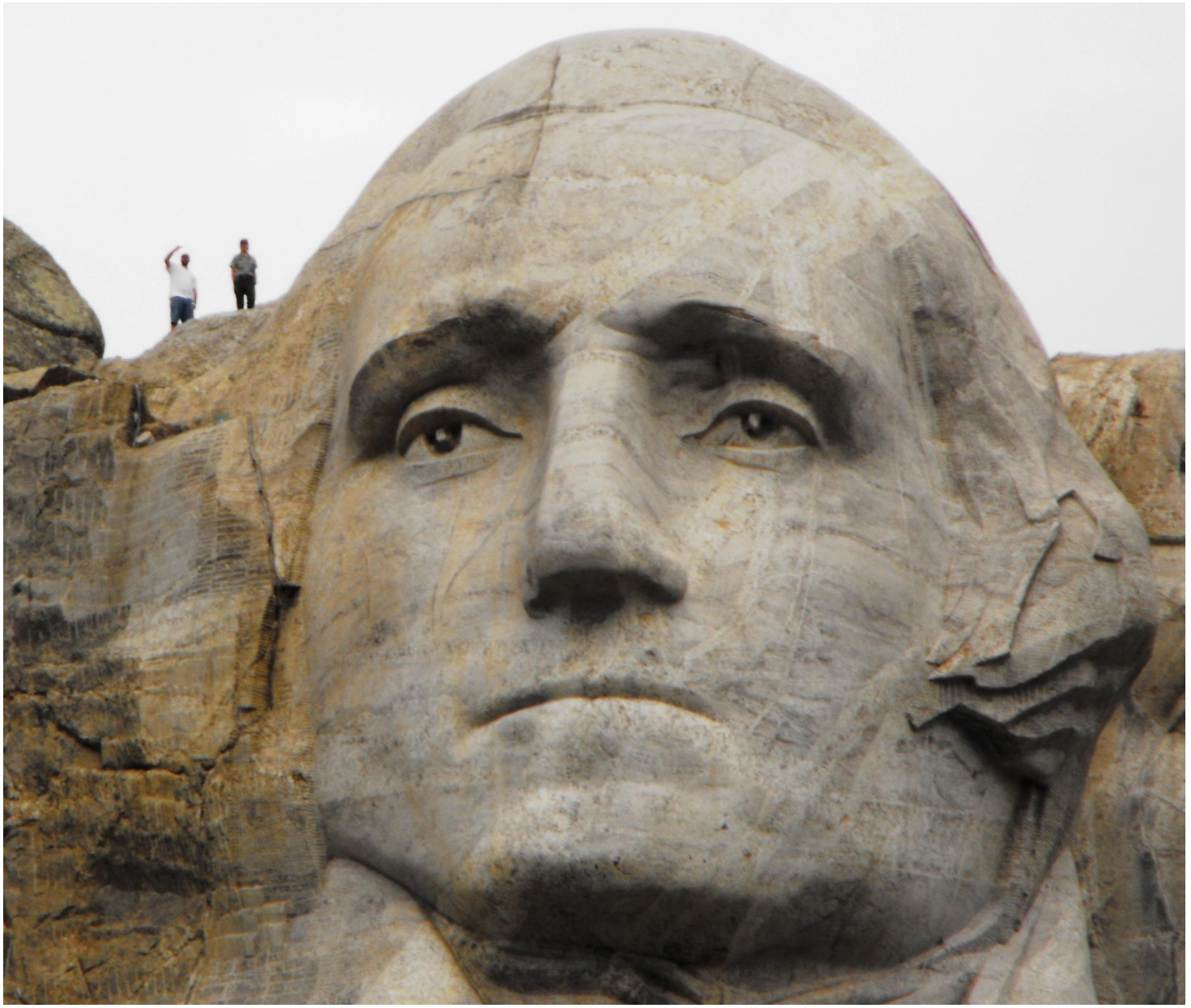
Early hand-tinted glass plate from: **Mount Rushmore: The Story Behind the Scenery**, 1993, KC Publications

Bringing The Eyes To Life

The irises of the eyes were sculpted as holes to always be in shadow, while the pupil is a 20-inch shaft of granite, the end of which reflects light

https://primalnebula.com/how-mount-rushmore-was-carved/

Driller (and baseball player) Nick Clifford in 2008 with Don Teter.
"The last of the carvers" died November 23, 2019 at age 98.



On Top of Old Georgie, 2008


83 Surveyors,
and one
other guy
South Dakota Society of Professional Land Surveyors
25th Anniversary - September 20, 2008

Carving Crazy Horse

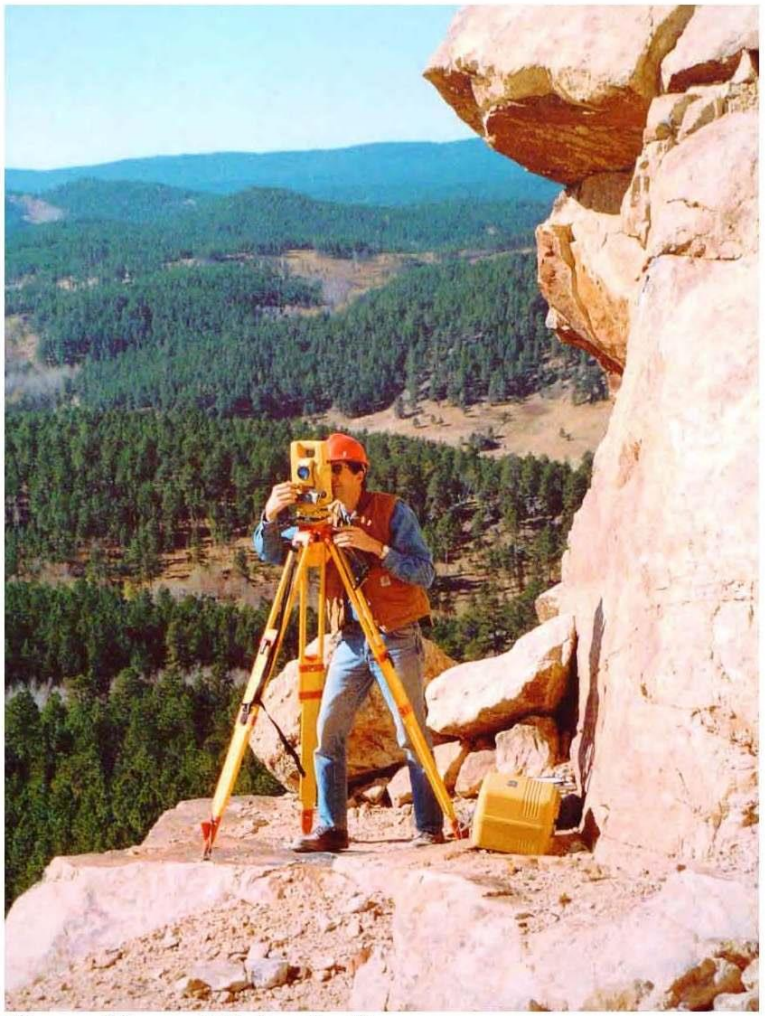
Construction Surveying

On Steroids

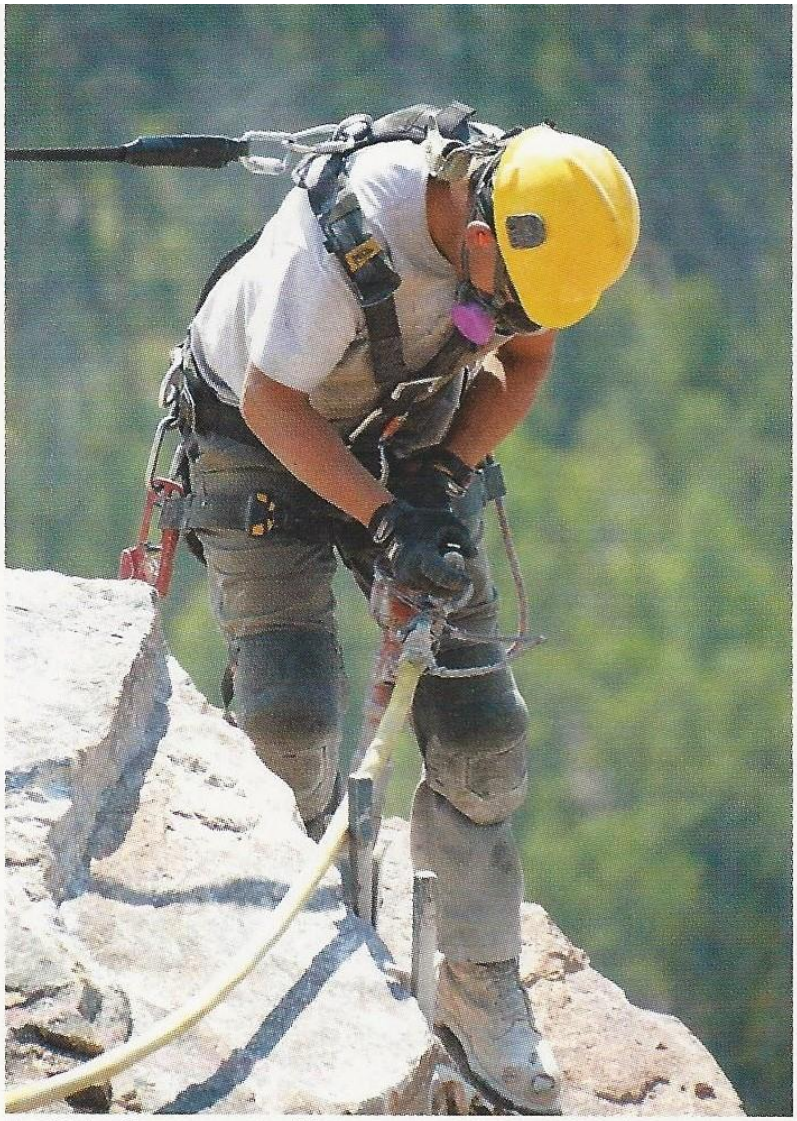
1948 - ????

The fingers emerging in 2023
From **Progress: News from Crazy Horse Memorial Foundation**, *Spring 2023*

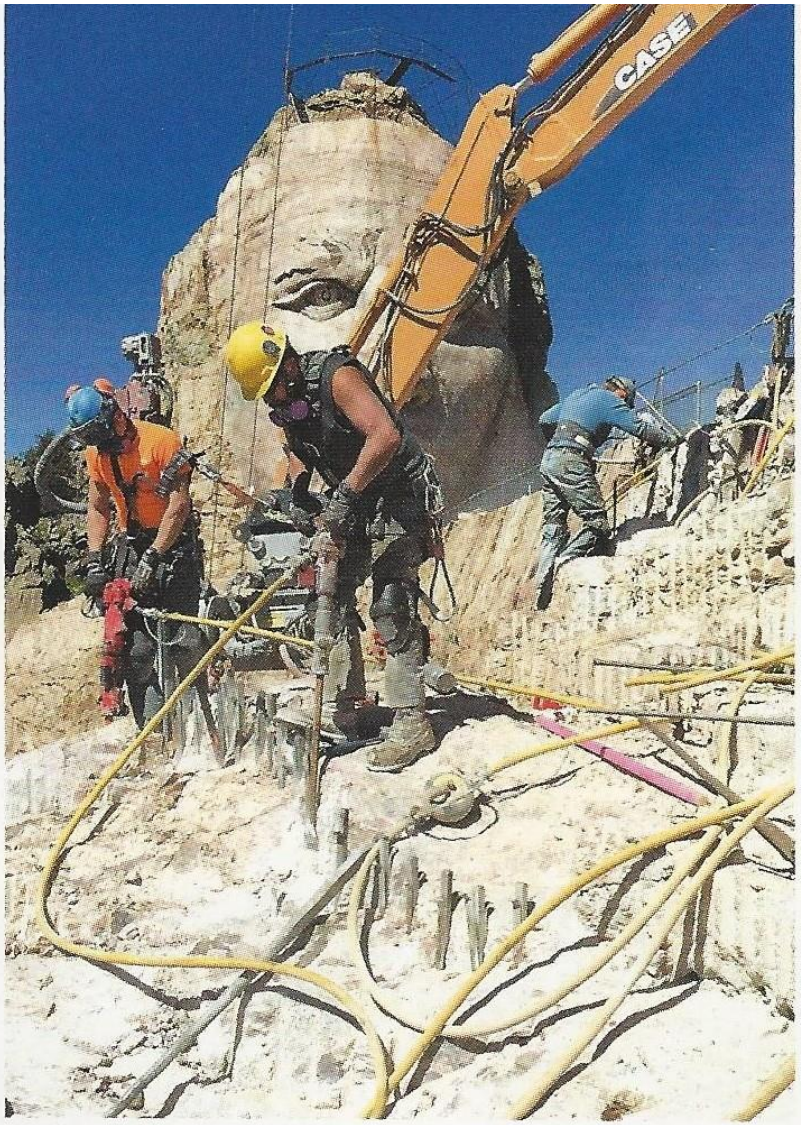
Plaster model 1/34 scale at visitor center, carving one mile in distance



From photos displayed in the Crazy Horse Visitor's Center.
(Left) In April, 1989, Mrs. Korczak (Ruth) Ziolkowski and her son Casimir demonstrate how the pointing system is used to transfer measurements using a plaster cast of the face from the 1/34 scale model.
(Right) Kevin Hachmeister surveying blast holes on October 16, 2000, with a Topcon 312 Total Station on permanent loan from Topcon.

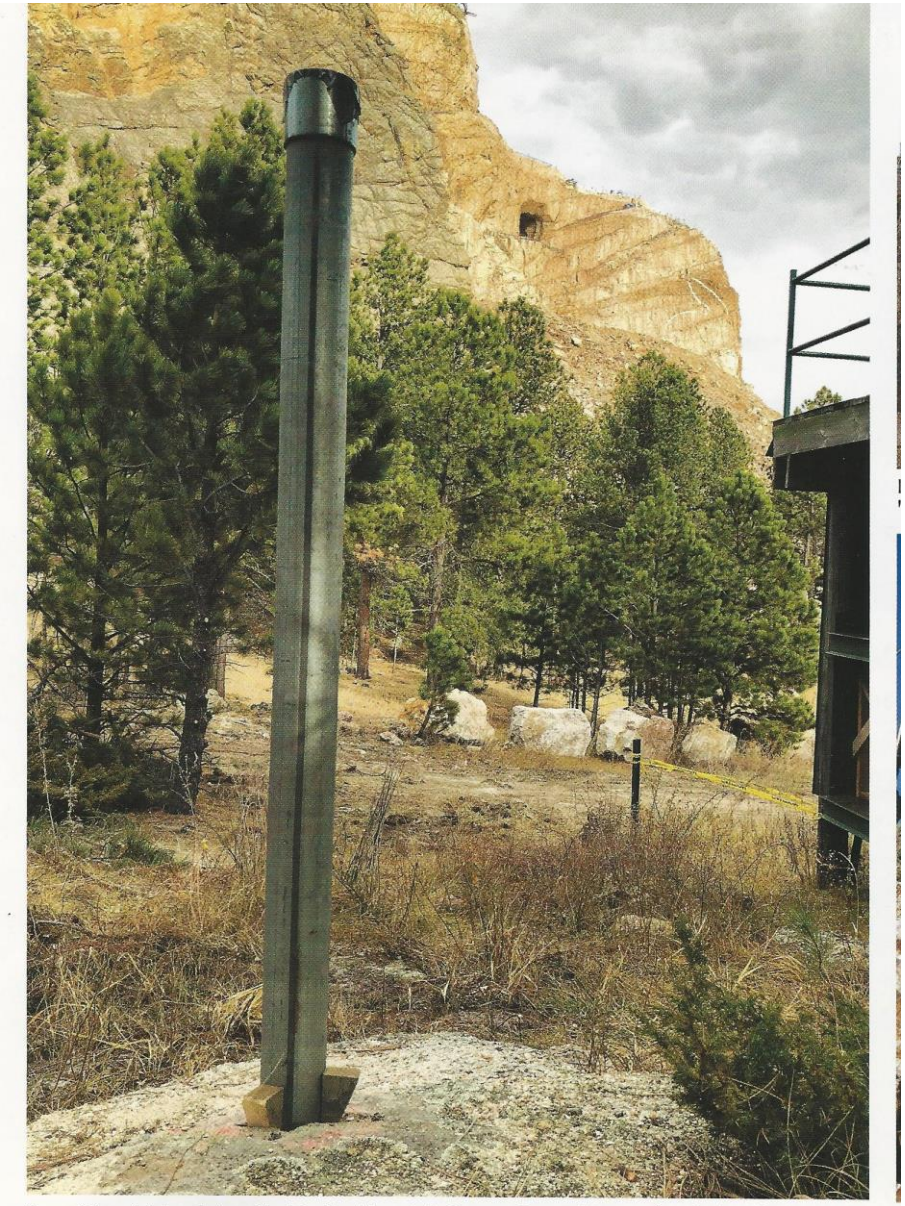


Paul Rooks uses a jackhammer with a special cup attachment to force wedges between feathers.



Paul Rooks, Vaughn Ziolkowski and Jeff Hermanson drill and set up feathers and wedges, processes done repeatedly.

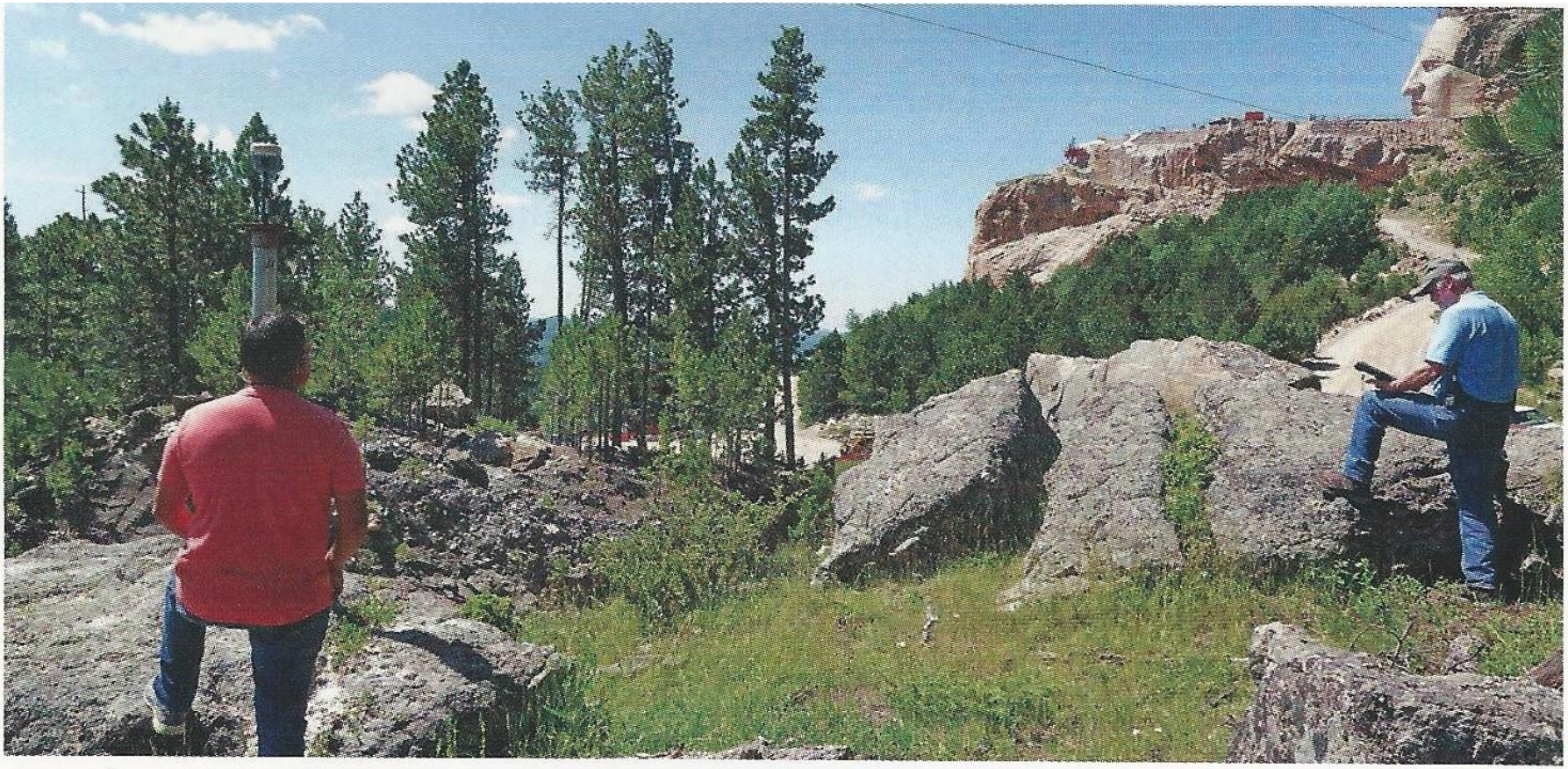
Progress, *Fall 2016*



One of the eight points added to the Mountain Survey Control Network, which will allow for surveying and laser scanning from additional areas on and around the Mountain.

"One of the eight points added to the Mountain Survey Control Network, which will allow for surveying and laser scanning from additional areas around the mountain."

Progress, *Spring 2019*



More frequent surveying is important to the future of the Carving as it nears finished grade.

Progress, *Fall 2019*

Using diamond wire saws
Progress, *Spring 2020*

Pointing machine in place on the hand.
From **Progress,** *Spring 2021*

The pointing machine recently placed on Crazy Horse's Left Index Finger has a time-tested system of measuring, which includes a plumb bob that can be lowered to desired points.

Progress, *Summer 2019*

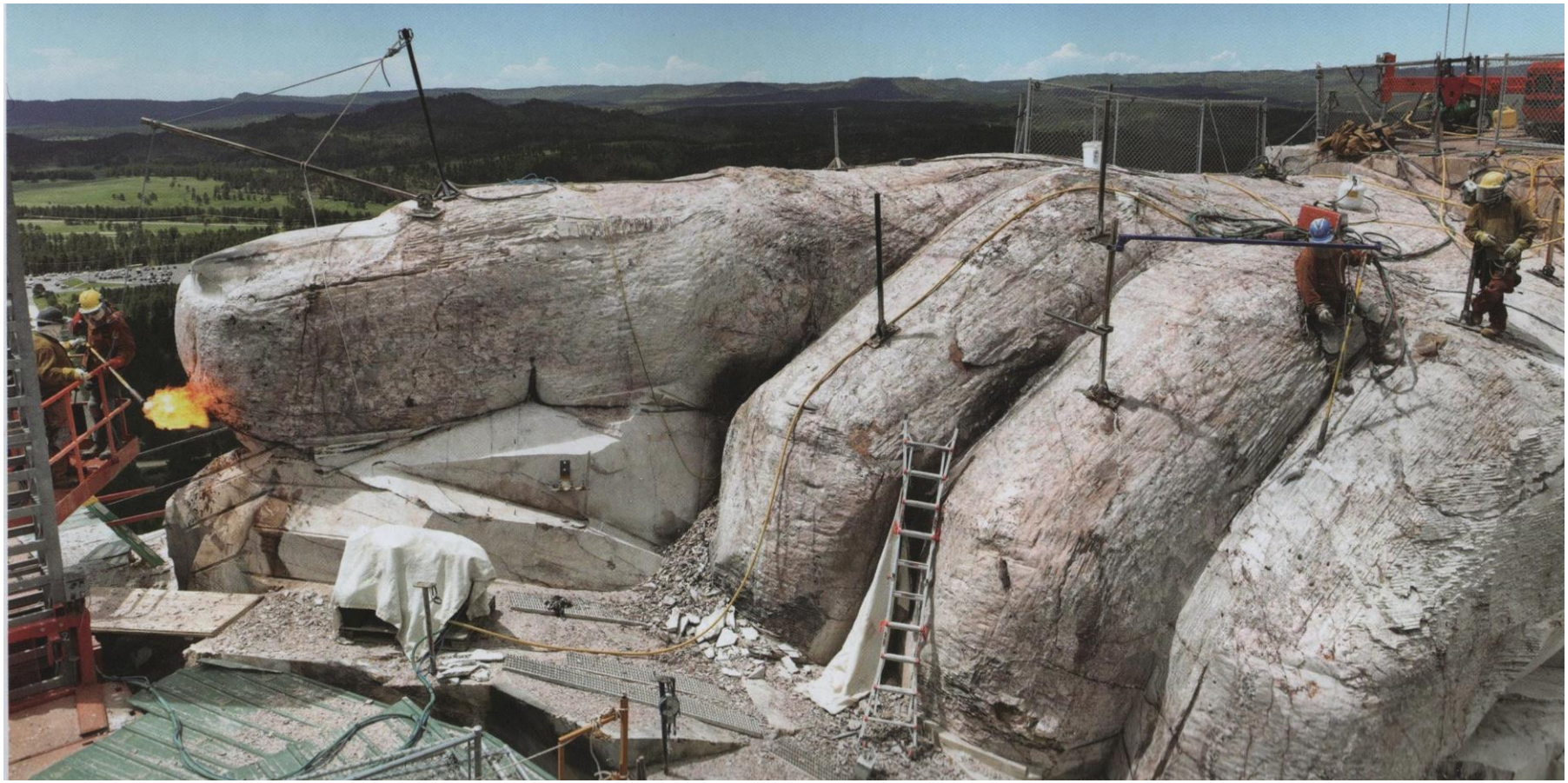
Jeff and Paul set up equipment to gather new data for the emerging Sculpture.

Progress, *Spring 2020*

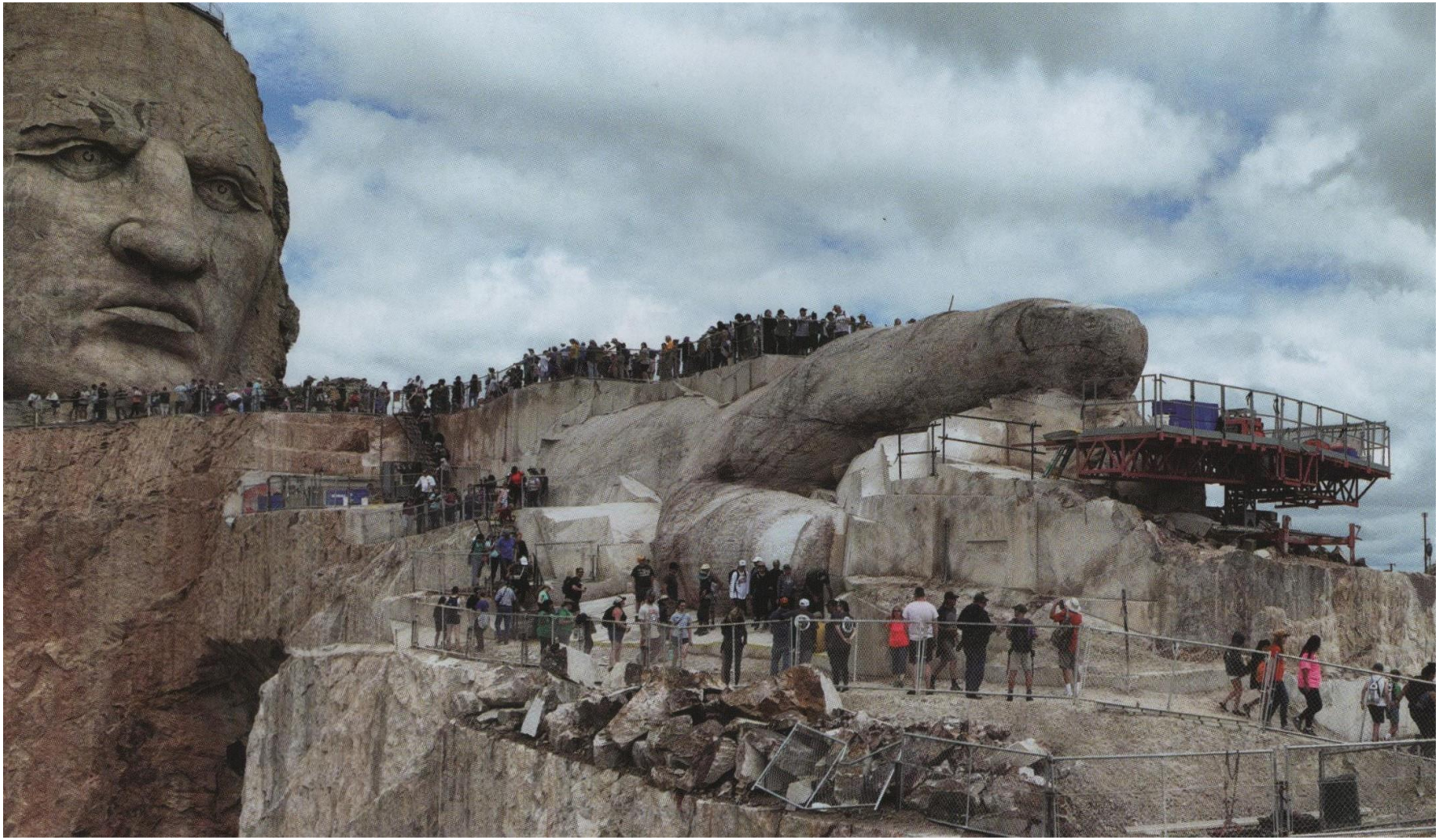
Surveying on the carving.
From **Progress**, *Spring 2021*

The Mountain Crew carefully drills several small holes to identify finished grade for torching.

Progress, *Spring 2021*



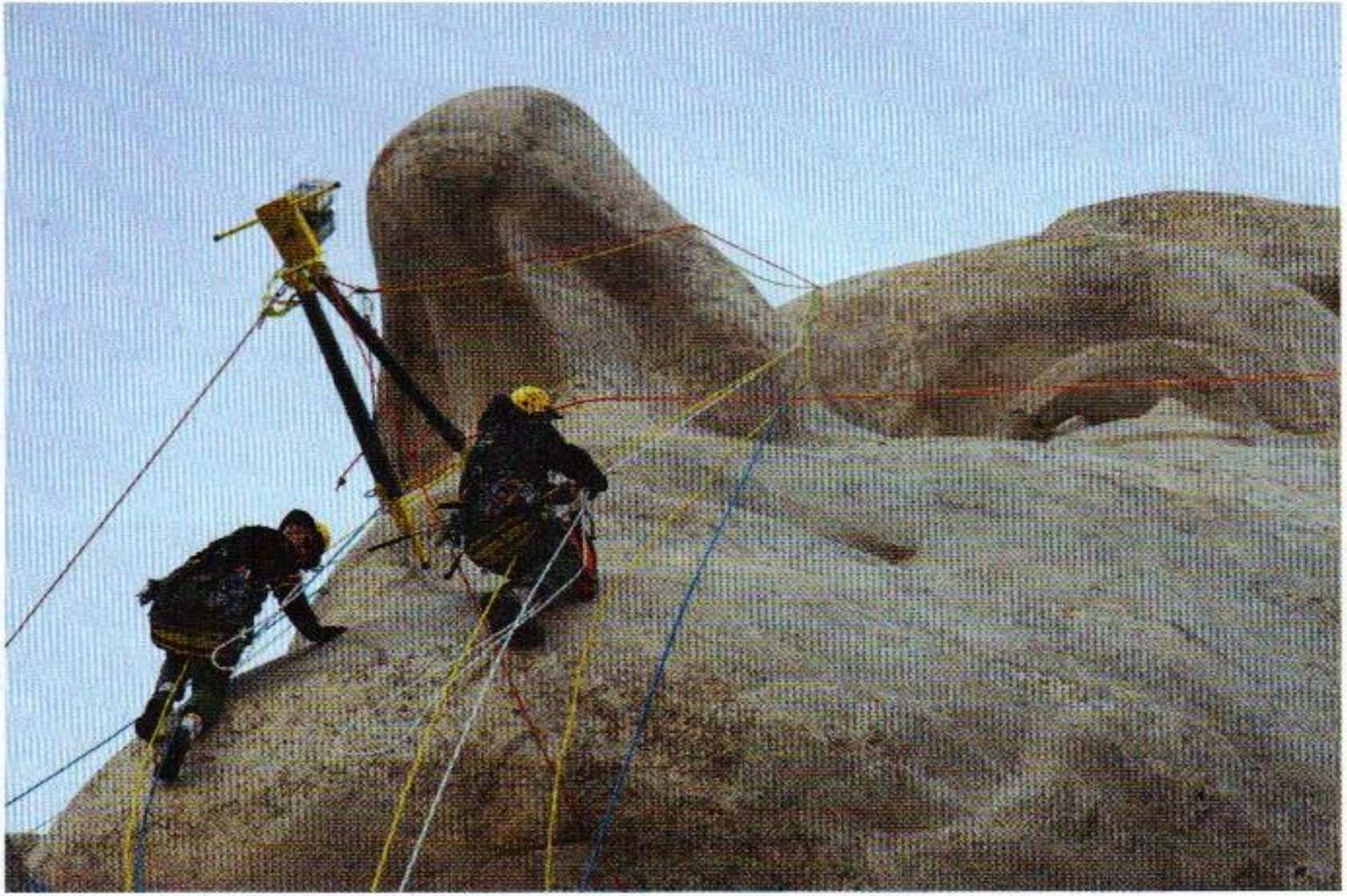
Some finishing work just before 75th Anniversary Celebration in 2023: torching several areas of the hand.
From **Progress**, *Summer 2023*



Spring 2023 Volksmarch
From **Progress**, *Summer 2023*

Scanning Rushmore

Back to the Future



"Digitizing the Legacy", ***The American Surveyor***, Vol 7, Number 7, 2010

SESSION EVALUATION

2025 SURVEYORS' Conference

HTTPS://WWW.SURVEYMONKEY.COM/R/2025PSLSEVAL