

According to Powell, Wheeler used Powell's more thorough results and properly credited them, "with his [Wheeler's] accustomed generosity." Consequently part of the celebrated overlap was only on the maps, since Wheeler had used some of Powell's data without actually reentering the same area. (Powell, 1878, pp.15-16)

The Survey under the direction of Lieutenant Wheeler was carried on during the early years by reconnaissance methods, as described above. They were carefully made, and I believe much more elaborate than any work of the same kind ever done before on this continent. In one important respect the refinement of the work was great; i.e., in the determination of a great number of geographic co-ordinates, longitudes, and latitudes, by astronomical and telegraphic methods. (Powell, 1878, p.17)

Despite this generous appraisal of Wheeler's work, Powell still called for a consolidation into a single system of mapping. The Interior Department had its own plan for mapping the West, intending to prepare an atlas of the area west of $99^{\circ}30'$ (but excluding Alaska) with rectangles $2\frac{1}{2}^{\circ}$ of longitude and $1\frac{1}{4}^{\circ}$ of latitude. (Powell, 1878, p.8) Because of the different scales of the maps, the different zoning, and the use of hachures by Wheeler rather than the contour lines favored by the Interior surveys, Powell felt that a single system was necessary. (Powell, 1878, p.18)

Also in April 1878 the normally pro-Wheeler Army and Navy Journal published an editorial attacking the Army participation in the Western exploration. Noting that once again Congress and the public were considering the union of the surveys, the Journal wrote that

of the surveys. Three of the surveys were still actively engaged in field work in the West: Wheeler's, Powell's, and Hayden's. While neither Interior Department survey wanted to subordinate itself to the other, Powell and Hayden had agreed to some joint limitations on their work, and the main confrontation shaped up between the Interior and War departments.

In April 1878 Powell submitted a report through the Secretary of the Interior. He began by listing his support from the Army, largely limited to logistical support. However, in sharp contrast to Wheeler's survey Powell actually had two Army officers as scientific assistants. (Powell, 1878, p.5) The first was Captain (Brevet Lieutenant Colonel) Garrick Mallery, who spent a year with Powell as an assistant in ethnographic work. The other was Captain Clarence E. Dutton of the Ordnance Department. Dutton was a graduate of Yale's Sheffield science school, and after a special act of Congress he was attached to Powell for several periods during the mid 1870's. Dutton's work in geology culminated in his Report of the Geology of the High Plateaus of Utah, issued in 1880. Following the consolidation of the surveys, Dutton headed an office of the Geological Survey for a time before returning to the Army.

Powell then went on to consider the meander method of survey in general and Wheeler's accuracy in particular.

But if a new reconnaissance survey is made by other routes of travel, the new map will coincide with the old one only to a limited extent. For this reason one reconnaissance survey cannot be said to duplicate another unless it is made by the same person travelling over the same routes. No such survey can be considered as final, and no such survey is of sufficient accuracy for scientific purposes. (Powell, 1878, p.15)

The existing surveys are and always have been antagonistic... drawing pay from the public treasury for three surveys of the same ground, all of them equally imperfect and worthless. While the contest has been disgraceful to all parties concerned, it has been especially so to the Engineer Corps... [which has] thus far put forward no one who has shown himself capable of conducting a work of this kind in the catholic and liberal spirit which is demanded. (Army and Navy Journal, 6 April 1878, p.556)

The editorial noted that many of Hayden's workers had started with the Engineer surveys, which had not been able to retain some of their top civilian scientists. Results had not been satisfactory. "Sir Joseph Hooker, in addressing an English scientific society, declared last autumn that Hayden's survey has not only done more than the others, but more than all the others combined." (Army and Navy Journal, 6 April 1878, p.556) Wheeler's emphasis was misplaced.

The [Wheeler] survey has not succeeded in making its work tell upon the prominent current questions that interest the world Its officers neglect the things that are keeping the world awake for those which, important enough in themselves, are by no means imminent. Their interest seems to be confined mainly to mathematical problems. . . . Wherever they go they rush into geodetic work with as much eagerness as if the figure of the earth was in constant change (Army and Navy Journal, 6 April 1878, p.557)

The Journal agreed that the national interest would benefit from a consolidation of the surveys, but remained hesitant to suggest Wheeler or the Army for the task.

Considering the relations of the nation to West Point, we conclude that it is among its graduates alone that the executive head of such an organization should be found. But when we look at what the Engineer Corps has accomplished, with the opportunities given it, we do not hesitate to say that its policy must be entirely changed before it can be trusted with this important work, without injury to the public interest. (Army and Navy Journal, 6 April 1878, p.557)

The entire tone of this attack on Wheeler seemed out of

context for the Army and Navy Journal, which up until that point had reported favorably on the progress of Wheeler's work. Indeed two years later the Journal would again praise Wheeler's and the Engineers' work. Listing King's valuable volume on mining and Wheeler's important monograph on the Comstock Lode, the Journal could find only Powell's work on arable and irrigable lands as a similar practical contribution by the Interior Department surveys. "Thus the Army may fairly claim that it did attempt to satisfy the popular demand for results that would be helpful to the people in the region explored." (Army and Navy Journal, 17 July 1880, p.1027) To further contradict its editorial of 1878, the 1880 article called for pendulum experiments to determine the exact shape of the earth and oceans. Like the society around it, the Army and Navy Journal does not appear to have been able to decide exactly what it wanted; practical results or scientific research.

By a congressional act of 30 June 1878, the question of the competing surveys was sent to the National Academy of Sciences for a recommendation. O.C. Marsh, as vice president and acting president, appointed a seven man committee chaired by himself to report back to the full Academy. The composition of Marsh's committee aroused criticism in Congress after its report was presented in early 1879. In a House speech, Colorado's T.M. Patterson declared that "One of them [Marsh himself] is a paleontologist of some renown; as a newspaper correspondent said, he is well qualified to take a spoonful of bone-dust and project from it a rara avis or some remarkable animal of the earliest geological age." (Congressional Record, 11 February 1879, ^{appendix} p.218)

Congressman Baker of Indiana commented that with five geologists, one dynamical engineer, and one naval officer on the committee, "Their deliberations resulted, as might have been expected, in a sort of kangaroo report . . . which recommends having a little scientific surveying at the head and a great deal of scientific geology at the other extremity." (Congressional Record, 18 February 1879. p.1563)

The National Academy of Sciences recommended combining all federal surveys into two organizations under the Interior Department. A new Coast and Interior Survey, ~~created from~~ the Treasury Department's Coast and Geodetic Survey, would handle the geodetic survey of the entire public domain, topographical surveying, and the land parcelling surveys for the settlement of the West. A new Geological Survey would study the geology and economic resources of the nation. Since it was almost completed, the Engineers could continue their survey of the Great Lakes. Otherwise the role of the Army would be eliminated, except for strictly military mapping. However military officers might be detailed to serve with either survey. ("Letter from the Acting President," 1879, pp.3-4)

The report of Marsh's special committee was approved by the entire Academy on 6 November 1878. General Humphreys had been on leave of absence since July and was not present, but two prominent Engineers, M.C. Meigs and H.L. Abbot, consented to the report. E.D. Cope, a bitter enemy of Marsh, cast the only vote dissenting from the recommendation. Then on 14 November General Humphreys created a sensation by resigning from the Academy in protest over

the exclusion of the military. (Manning, 1967, pp.43-44)

General Humphreys wrote a letter that claimed if the plan were adopted, scores of years would elapse and millions of dollars be spent before the survey of the West could be completed.

That a survey of an extended area aiming at the highest degree of accuracy should be a rigidly exact, geodetic survey, is evident to all, but what practical good is to be attained by the enormous expenditure that such a system of survey requires is not evident. (Army and Navy Journal, 18 January 1879, p.416)

Humphreys advocated the continuance of the current Corps of Engineers surveys, for then

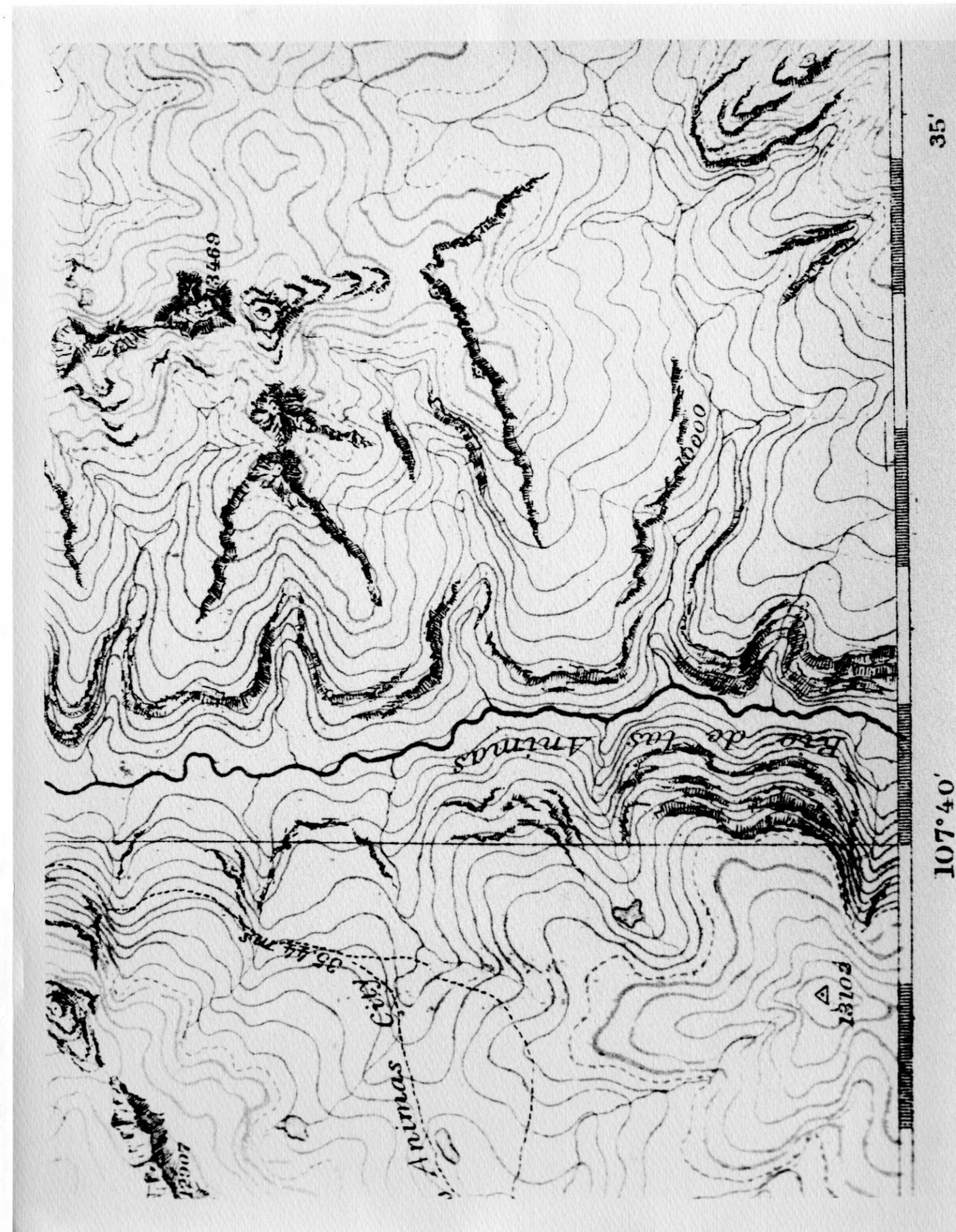
The survey of the whole interior region would be completed in ten or fifteen years at a cost of not exceeding \$2,000,000, and with all the accuracy that the wants of the War Department and a newly settled and thinly populated country require. (Army and Navy Journal, 18 January 1879, p.416)

Humphreys then made several cost estimates that later got him into trouble. With 816,000 square miles remaining to be mapped, General Humphreys estimated the Coast Survey cost at \$584 per square mile. That would mean \$475,000,000 to complete the mapping of the West. (Army and Navy Journal, 18 January 1879, p.416)

A letter from H.G. Wright, the acting Chief of Engineers in the absence of Humphreys, had accompanied the report of the National Academy of Sciences to Congress. Wright had stressed the need of the War Department for maps, and the lack of necessity for really accurate (and expensive) maps. The Engineers had already mapped 300,000 square miles, in sufficient detail for the War Department and the needs of the nation at that time. Thus Wright suggested that the Engineers continue their mapping program, while the Interior Department could choose for itself the areas

Map 3.

This is one of Wheeler's maps that used contour lines instead of the hachures criticised by Powell and others. The sheet covers the San Juan mining region of Colorado. The section shown is enlarged; the original scale of the map is two miles to the inch, with a 250 foot contour interval. The mapping field work was carried out in the 1874 and 1875 expeditions, under the direction of Lieutenant Marshall. The topographical assistants credited are J.C. Spiller and Louis Nell.



worthy of detailed study while the Army concentrated on general reconnaissance mapping. ("Letter from the Acting President," 1879, pp.7-8) An accompanying letter from Hayden suggested that topography and geology not be divorced, since with a small added cost the geology could be combined with the topographic survey. ("Letter from the Acting President," 1879, p.12)

Powell then jumped into the contest with a letter dated 7 February 1879. He claimed that Humphreys had vastly overestimated the cost of surveying by the civilians, and the extreme accuracy and difficulty encountered in charting the coastline would not affect the cleared areas of the West.

From practical experience I am able to state that a topographic survey made with all the accuracy and refinement necessary for the scale established by the Interior Department, i.e. one inch to four miles, can be made for \$2 per square mile [which would cover all expenses except engraving and publication of the maps]. (Powell, 1879, p.3)

Meanwhile the Engineer estimates were "for inaccurate topographic work, valueless for scientific purposes and valueless for all the purposes for which maps are made in the administration of the Interior Department," because the maps were without proper geodetic basis, without proper hypsometric basis, used hachures instead of contour lines to vaguely represent topography, and because areas the size of Connecticut had been mapped but not actually entered. The Engineer maps would cost nearly as much as the more accurate maps Powell could produce. (Powell, 1879, p.3) (See Map 3 for one of Wheeler's maps that did use contours.) Powell derided the "Geographic surveys under the War Department, including a quasi system of geography and topography." (Powell, 1879, p.4) He

concluded with an argument for Interior Department map-making. "If the maps are properly constructed, all military purposes are subserved, and it matters not by whom the work is done." The maps made by Interior Department workers were more accurate than Wheeler's, and hence even the Army would benefit from civilian control of the surveys. (Powell, 1879, p.5)

During debate in the House, the question of the utility of the surveys again surfaced. Wheeler and the Engineers found no support, so that debate proceeded without any chance of a further Army role. New York's representative Hewitt characterized the Engineers as "a military organization not popularly associated with scientific pursuits," and while he admitted that initially he had accepted their role as surveyors in the West he could no longer accept the wisdom of Army control over a scientific venture. For one thing, Hewitt pointed out that

It is not to be expected that the large body of scientific men required to make these surveys will consent, willingly, to place themselves under the control of the younger officers of the Engineer Corps. Whatever may be their devotion to science, they are men of such eminence in their respective walks that they cannot and ought not to be reduced to the ranks. (Congressional Record, 11 February 1879, p.1204)

Hewitt's reason probably explains the fact that such Army officers as Dutton and Mallery could be detailed for work with Powell but would not be sought by Wheeler. As his seniors these men would usurp Wheeler's leadership of the surveys west of the hundredth meridian.

On the floor of the House, Kansas representative Haskell read a letter that probably was written by E.D. Cope, although the identity of the author was not disclosed. (Manning, 1967, p.51)

Identified only as a member of the National Academy of Sciences, the letter writer claimed that "They [the Academy committee] have a scheme for placing a graduate of one of their colleges in the single position which it to represent those now filled by Hayden, Wheeler, and others." (Congressional Record, 18 February 1879, p.1560) Representative Baker of Indiana attacked the whole idea of a general geological survey, questioning its value to the nation.

Such a dazzling scheme for enriching the science of geology at the expense of the overburdened tax-payer was never before projected. . . . How much more will the Government obtain for the lands if it should be ascertained by this geological survey that some millions of years ago enormous ichthyosaurii and other primeval aquatic monsters sported in waters which once covered some pioneer's farm? (Congressional Record, 18 February 1879, p.1564)

Colorado's T.M. Patterson also scored the scientific as opposed to the land distribution surveys. In particular he singled out some projects of the Coast Survey. "Some of them, they say, are watching the vibrations of pendulums in a far-off state, for some occult scientific purpose no doubt." (Congressional Record, 11 February 1879, appendix p.219)

Despite the doubts raised in Congress, the Geological Survey was established through the strategem of authorising money for the survey in an appropriations bill although no legislation had otherwise mentioned the new agency. Powell played a very influential role in the entire process, but then contentedly retired to the new Bureau of Ethnology. Hayden had lost in the political infighting in the National Academy of Sciences and Congress, and instead King stepped forward as a dark horse candidate to gain the

first directorship of the Geological Survey. (Dupree, 1957, pp.208-210)

Once the National Academy of Sciences committee had reported back with its recommendations, the Army Engineers no longer retained any chance of maintaining a role in the Western exploration. One member of the committee was William P. Trowbridge, a West Point graduate. First in the class of 1848, Trowbridge spent 1848-1850 at the Military Academy Observatory. Resigning in 1856, he served on the faculties of the University of Michigan, Yale, and Columbia. In 1878 Trowbridge was professor of engineering at Columbia's School of Mines. (Register of Graduates, 1970, p.240; Manning, 1967, p.41) Simon Newcomb of the Naval Observatory was also a member of the committee, yet neither of these two truly represented the military. The great military scientists--Humphreys, M.C. Meigs, H.L. Abbot, and C.B. Comstock--were excluded by Marsh when he picked the committee because the Yale paleontologist feared a minority report advocating a military role. (Manning, 1967, p.41) Newcomb termed Humphreys's resignation from the Academy "a sort of hari-kari," (Dupree, 1957, p.208) and his active entry into the debate hurt the Army cause and ended any chance of maintaining an active role in the West. (Manning, 1967, pp.44-46) Thereafter the only questions for discussion centered on the value of any survey at all and who should head such an organization.

Field work for Wheeler's survey continued until the end of June 1879, after which time Wheeler worked in Washington to finish the office work of the survey. The final volume, the geography report which was the one volume of the final reports that was

primarily Wheeler's own work, appeared in 1889.

VENICE GEOGRAPHICAL CONGRESS.

In 1881 Wheeler was sent as American delegate to the Third International Geographical Congress and Exhibition at Venice. The new Geological Survey did not enter either its own work or that of its predecessors among the Interior Department surveys. The elaborate display prepared by Wheeler representing both his own work and some of King's efforts for the War Department thus constituted the major exhibition on the American effort in the West. For his efforts Wheeler returned with two letters of distinction, the highest of the four categories of award. The first came in Class I, mathematical geography, geodesy, and cartography, to "Geographical surveys west of the one hundredth meridian (Wheeler), for completeness of cartographical and other works." The second letter of distinction rewarded Class III, physical geography, meteorology, geology, mineralogy, paleontology, zoology, and botany, to "Geographical surveys west of the one hundredth meridian (War Department), for completeness of geological and other natural history works west of the Mississippi River." (Wheeler, 1885, pp.48-49)

Four years later Wheeler issued a report to Congress on the Venice congress, apologizing that "The scope of this report has somewhat exceeded my expectations, since, having been undertaken when in a delicate state of health and while attempting to recover from a long and dangerous illness." (Wheeler, 1885, p.13) In this report Wheeler summarized the proceedings of the congress,

reported on the topographical surveys in the various nations of the world, and lobbied for a resumption of the topographical surveys under the Corps of Engineers.

Wheeler lamented that

No organization for the prosecution of systematic general topographic surveys exists in the United States. The Geological Survey, organized by statute in 1879, for purely geological purposes . . . is carrying on topographic field operations at widely divergent localities in the older as well as the newer States, from a geologic standpoint, i.e. based on triangulation "sufficiently correct" only for the scale of the map employed, and with undue weight attached to the topographic relief of the natural features as compared with the details of communication and artificial and economic features of the ground. (Wheeler, 1885, p.99)

On the other hand, he emphasized that his own survey had

. . . proceeded from an almost diametrically opposite standpoint, [the primary emphasis] giving due weight to the astronomic, geodetic, and topographic observations, with map delineations of all natural objects, means of communication, artificial and economic features, [and with] the geologic and natural history branches being treated as incidental to the main purpose. [Wheeler's was] the only organized, systematic, topographic work with a practical basis ever begun in the United States. Just as its organization . . . was brought to a high state of efficiency . . . the appropriations were suspended. Geology in organic form was established in the Interior Department, the vastly more important work of topography was disregarded, and left unprovided for . . . resulting in a direct and positive step backward, without precedent in the civilized world. (Wheeler, 1885, p.100)

Wheeler then proceeded to attack the scientific establishment and the Geological Survey.

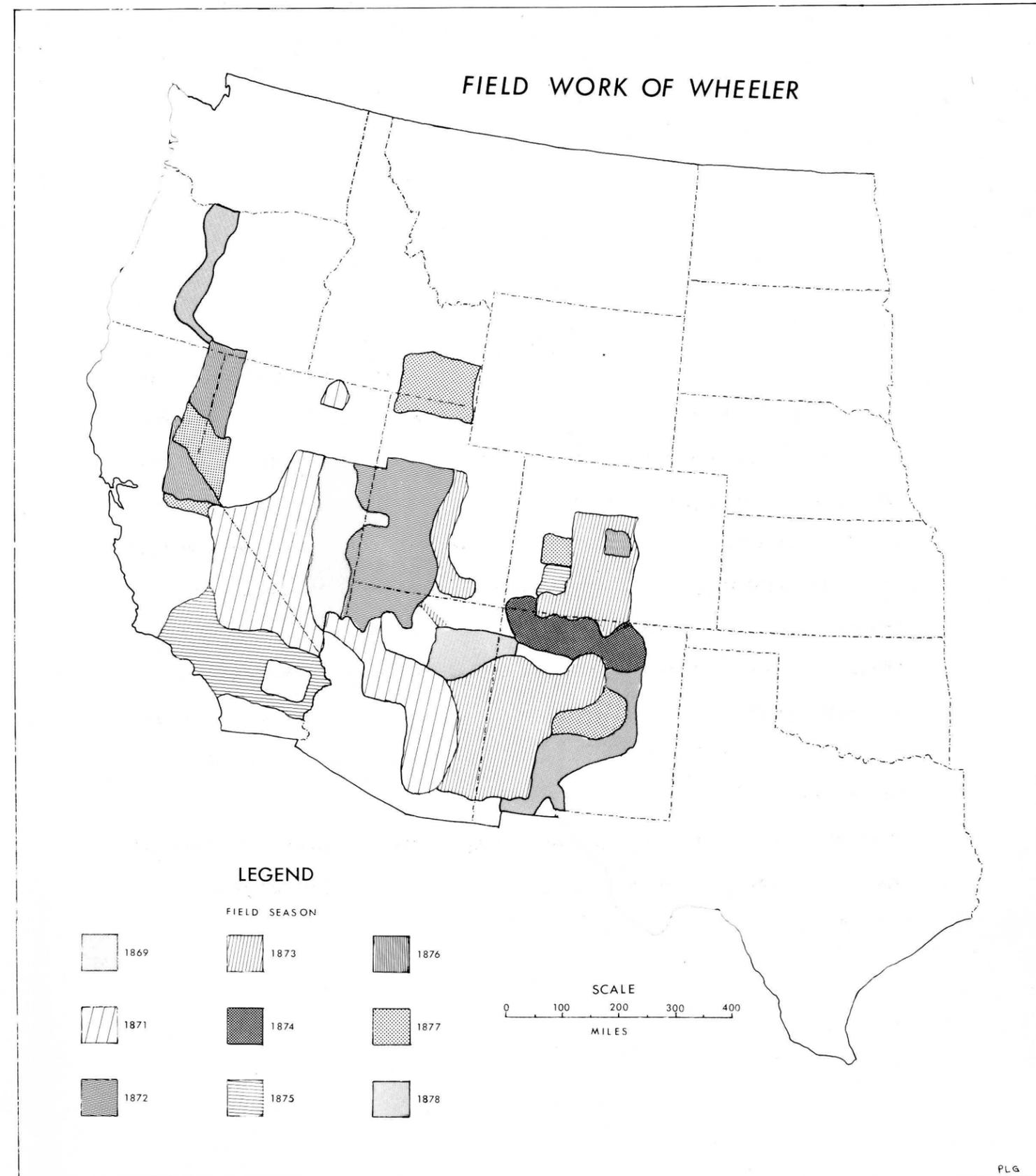
[Wheeler's own funds were cut off] on account, it is believed, of persistent unjust adverse claims set up by certain geologists and others in the name of science. . . . There is nothing yet officially published by the above officer [the Geological Survey], except the assertions of the director (who is not an authority in astronomy, geodesy, or topography as applied to surveys) indicating the true value of any results in these three branches of its work as at present prosecuted for the purpose of obtaining the topographic base upon which to illustrate the geology. (Wheeler, 1885, pp.468,472)

Map 4.

Based on his annual reports, this map shows the areas worked in by the Wheeler survey for the years 1869-1878. Especially during the later years when the survey was divided into many small parties, the areas worked in each season were not clearly separated. The general outlines are depicted, with the understanding that the areas of central Colorado and around Lake Tahoe were worked in over a period of several years. The map thus depicts new areas first entered.

At some point a party swung down to the California, Arizona, and Mexico border area, but the year could not be clearly determined.

The swath across northern Nevada and Utah that was not mapped was the area of Clarence King's survey, an area Wheeler did not reenter.



Finally Wheeler summarized his accomplishments in mapping the West. Of the 1,443,360 square miles beyond the hundredth meridian, the mountainous part which was most important for mapping comprised 993,360. Wheeler's parties had surveyed topographically 359,065 square miles and published maps of 326,891. (See Map 4 for the areas worked in by Wheeler's parties between 1869-1878.) He and his men had published 50 topographic sheets, 33 land classification sheets, 11 geological sheets, 16 special and miscellaneous maps, and 54 maps with reports and publications. In total Wheeler claimed 41 publications and 164 maps for his surveys. (Wheeler, 1885, p.486)

But Wheeler felt that his job was not over. It was a "prextentious claim" that the job had been taken over by the Geological Survey. His maps

Will furnish all the practical topographical information required by the Government and people in these thinly settled areas. With the necessary later revisions, as slowly-increasing settlement shall demand, it becomes of permanent value. . . . Various circumstances (especially the temporarily successful claim of certain geologists to the control of Government topographic work) have conspired to delay its execution. (Wheeler, 1885, pp.486,489)

ARTICLE FOR COSMOPOLITAN.

Wheeler never doubted that the nation would see the necessity for the topographic survey of the West, and once again entrust the task to the Army Engineers. In August 1898 he wrote an article for The Cosmopolitan on the need for a general staff, again providing a forum to preach topography as a military duty. "In peace . . . the study of theaters of war and preparataion of

military maps . . . should have been . . . prosecuted." (Wheeler, 1898, p.465) Wheeler spent a page listing the duties of a general staff, and naturally topography was listed--three times.

The functions and duties of the Great General Staff, and the General Staff with troops, are the following in the aggregate for Continental Europs-- . . . astronomic, geodetic, and topographic admeasurement surveys, which never cease; . . . strategical information, including topography of home and foreign countries; geographical data and statistics; . . . preparation of maps; . . . (Wheeler, 1898, pp.467-468)

Concluding his article, Wheeler wrote that "it would seem that we are now ready to resume again the march of Industrial Conquest, which if anything if the destiny and purpose of our republic." (Wheeler, 1898, p.470) Wheeler's effort had always been to advance that purpose, and he saw the greatest contribution that he and the Army could make would be the complete mapping of the entire West. To that end he had organized his survey, and then lobbied for Congress to return to the Engineers that function of topographical mapping.

WHEELER NATIONAL MONUMENT.

Three years after Wheeler's death, on 8 December 1908 President Roosevelt proclaimed that 300 acres of Rio Grande National Forest would be the Wheeler National Monument. It was named in honor of George Montague Wheeler, "leader of many surveying and exploring parties of the early 70's, who did much to blaze a way for settlement in that part of the West." The monument was on the south slope and near the summit of the Continental Divide in Colorado, twenty miles from the Rio Grande Railroad at Wagon Wheel Gap. The area was noted for the beauty

of its erosion-formed landforms, and was believed to be the area where Fremont's expedition was overtaken and forced to turn back. (National Geographic, September 1909, p.837) As of 1975 the Wheeler National Monument was no longer listed by the National Park Service.

CONCLUSION.

In retrospect Wheeler seems to have failed to convince Congress of the value of his survey for two reasons. First the question of the value of any Western exploration was under serious question. The nation would no longer continue the luxury of three separate surveys, competing to a degree and lacking central coordination, even if the objectives differed slightly among the three surveys. Secondly, once the need for consolidation (if not total elimination) was settled, the Army could not compete with the civilian scientific establishment. Had Wheeler been able to show justification for his plan of topographic mapping, he would have further needed to show the special qualification of the Army.

Ironically Wheeler may have helped along his own demise. With his surveys he removed himself and the other lieutenants who served with him from the drudgery of frontier duty. Instead of being assigned to some "Fort Garland, where we encamped for two days, [and which] is so isolated that we pity the two companies of cavalry stationed there" (NY Times, 3 July 1875, p.3), the young lieutenants assigned to the survey had the excitement and challenge of exploration. Yet perhaps Wheeler failed to stress enough the military nature of his work. The military personnel seem to have left behind their uniforms, so that to a casual observer little difference would be apparent between a party of

Wheeler's or one of Hayden's. Rideing described the 1875 season with Morrison: "Officers and men alike dressed in buckskin or heavy cloth trousers, with a belt and bowie-knife, thick blue or gray flannel shirts, high boots, and sombrero hats." (Rideing, 1876, p.795) The next season he described Lieutenant Maccomb, "divested of every garment that could indicate his rank or regiment, his picturesque blue and red artillery uniform substituted by a sombrero hat, a gray flannel shirt, corduroy breeches, boots reaching above the knee and jingling Mexican spurs." (NY Times, 9 October 1876, p.3)

Further the incidental scientific work was almost totally completed by civilians, with only a few exceptions; Army lieutenants assigned to the survey did produce some short reports on scientific subjects rather than technical aspects of mapping or astronomy. Lieutenant Rogers Birnie of the 13th Infantry had two pages in the 1875 annual report on some of the Indian ruins visited, and Lieutenant W.L. Carpenter of the 9th Infantry wrote five pages for the 1876 report on the alpine insect fauna of Colorado and New Mexico. Perhaps significant, both of these officers came from the Infantry rather than the Engineers. Carpenter was not a West Pointer, and served with Hayden as well as Wheeler. (Bartlett, 1962, p.353) These exceptions only point up the extent of the civilian domination of the scientific work carried out by the Wheeler survey.

In choosing his scientific workers, Wheeler showed good judgment, selecting many men with superior talents and reputation. Edward D. Cope, Charles A. White, and Fielding B. Meek who did