

MEMOIR
OF
FERDINAND VANDIVEER HAYDEN.
1839-1887.

BY
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J. V. Hayden

BIOGRAPHICAL MEMOIR OF FERDINAND V. HAYDEN.

Mr. President and Members of the Academy:

Although Dr. Hayden was so long and so widely known to the public, and although I was many years personally acquainted with him, I have met with considerable difficulty in obtaining certain data upon which I desired to base the memoir which I have prepared, and some which I thought it would be appropriate to use I have been quite unable to obtain. The memoir is therefore not so full in some respects as I wished to make it. A part of the statements therein contained are the result of my personal recollections, but most of the facts which relate to his official work have been collated from public records. Those which relate to his personal history I have obtained mainly from his widow, Mrs. Emma W. Hayden, but in large part from Dr. Albert C. Peale, who was his intimate friend to the end of his life and who has himself prepared a biographical sketch of Dr. Hayden. The manuscript of that sketch Dr. Peale has generously allowed me to consult in the preparation of this memoir.

Ferdinand Vandiveer Hayden was born at Westfield, Massachusetts, September 7th, 1829. He was a son of Asa Hayden, whose father is said to have served in the Continental army during the Revolutionary war. Ferdinand's father died when the former was about ten years old, and his mother, marrying again, went to live in New York State. Two years after his father's death the boy, finding his home uncongenial, went to live with his uncle on a farm near Rochester, Lorain county, Ohio.

I have been able to learn comparatively little concerning Ferdinand's boyhood, but it is evident that he was unusually studious, and that he fully improved all the opportunities he had for study, because, notwithstanding his exacting labors on the farm, he was able to teach successfully in the district school of his neighborhood during the winter of his sixteenth year. He continued to work on his uncle's farm and to teach during the winter months until he was eighteen years of age. His uncle then offered to adopt him as his

son, but Ferdinand promptly declined the offer, the life of a farmer being uncongenial to his tastes and not in accord with his ambition. He was eagerly desirous of an education and, leaving his uncle's house, he went to Oberlin, the seat of Oberlin College, and being without money to pay for his transportation, he walked all the way. Arriving in Oberlin, he stated his case and his desires to President Finney. That earnest and experienced educator extended to the anxious boy his advice and sympathy, the result of which was that he began at once the requisite preparation for a college course at Oberlin, working meanwhile to earn money to pay for his support and tuition.

Some of those who were his classmates have spoken of him as having been shy and diffident, and despite his acknowledged earnestness and studious habits, they did not predict for him a prominent career; but it may well be questioned whether that shyness and diffidence were inborn or due to severe, if not cruel, buffetings which the well-nigh friendless boy encountered almost from his infancy.

Having completed his preparation in 1847 he entered the class of 1850, overtook them in the advance they had made in the course of study before he entered, and graduated with them in the last-named year. It is a remarkable but apparently a well authenticated fact that from the time he left his uncle's house almost penniless to the time of his graduation he never received any pecuniary assistance, but paid all his expenses with the labor of his own hands, and meantime more than kept pace with the studies of his class.

Upon his graduation from Oberlin with the degree of A. M. he devoted all his time to the study of medicine, having chosen that profession for his career. In pursuance of this object he at once matriculated at Albany Medical College, Albany, New York, and was graduated from that institution with the degree of Doctor of Medicine in 1853.

During his course of medical study at Albany he became acquainted with Prof. James Hall, and through that acquaintance became intensely interested in the subject of geology. At this time public attention was largely drawn to the discoveries of fossils which had been made west of the Mississippi by Dr. John Evans, Dr. D. D. Owen, and others. Professor Hall was desirous of obtaining information concerning the geology of that region, toward which he had already extended his own observations. Finding his young medical

acquaintance enthusiastic, that experienced geologist proposed to furnish the means for exploration, provided he should have the results for study and publication. Accompanied by Mr. F. B. Meek, who was then acting in the capacity of paleontological artist to Professor Hall, Dr. Hayden left Albany in the spring of 1853 for what was then known as the Upper Missouri Bad Lands. The two young men visited the region where five or six years before Dr. John Evans had made his wonderful discoveries of fossil vertebrate remains. Returning to Albany in the autumn of the same year, Dr. Hayden faithfully fulfilled his agreement with Professor Hall, delivering up to him all his collections and field notes, most of which pertained to formations of Cretaceous and Tertiary age.

The vertebrate remains of those collections were studied by Dr. Joseph Leidy, and the Cretaceous invertebrates were published jointly by Professor Hall and Mr. Meek in the *Memoirs of the American Academy of Arts and Sciences at Boston*. That publication was accompanied by a vertical section of the formations from which the fossils were obtained, which is understood to have been the joint work of Dr. Hayden and Mr. Meek, although the name of the former does not appear in the publication referred to.

During his exploration for Professor Hall, Dr. Hayden became so thoroughly interested in the great region then generally designated as Nebraska, but now comprising several large States, that he determined to devote himself to its geographical and geological exploration. His labors in that direction for the next twenty-five years, and the manner in which he prosecuted them, are so characteristic of the man that a concise and consecutive account of them, followed by a statement of other matters of his personal history, will, I think, best illustrate my subject.

Not having money enough to carry on independently the explorations upon which he had determined, he sought and obtained permission to travel a part of the time with parties of the American Fur Company on their annual trips for trade and hunting in that country. Starting in the spring of 1854, two years were spent by him in toilsome journeys, traveling largely on foot, often sleeping upon the ground where night overtook him, and occasionally eking out his expenses by working for the few traders who were scattered over that region. In this way he traversed the valley of the Missouri river from the western boundary of the then Territory of Iowa to Fort Benton, now a principal town of the state of Montana.

He also traversed the valley of Yellowstone river from its mouth to the mouth of Big Horn river. In these journeys his sources of supply and protection were the boats of the American Fur Company, which were then ascending those rivers. Their slow progress enabled him to spend much of his time ashore, noting geological structure and collecting fossils. Returning from these long, wild journeyings, Dr. Hayden reached Saint Louis, Missouri, early in 1856, and for a time made his headquarters there.

The geological notes made by Dr. Hayden during those two years of exploration have served as the basis for constructing a section of the formations of that region which remains with only slight changes to this day, and his geological notes served in part as the basis of subsequent explorations under the auspices of the United States War Department. The large collections of fossils which he then made opened to the scientific world a knowledge of extinct faunas such as had never before been known, and the discoveries which he thus inaugurated have been among the most remarkable in the history of biological geology.

Dr. Hayden deposited his large collections of fossils in part with the Academy of Science of Saint Louis, and in part with the Academy of Natural Sciences of Philadelphia. The vertebrate remains were described by Dr. Joseph Leidy, and the invertebrate remains were published jointly by Mr. Meek and Dr. Hayden, the greater part of all these descriptions having first appeared in the publications of the Philadelphia Academy.

A few weeks after Dr. Hayden's return to Saint Louis he received from Lieutenant (afterward General) G. K. Warren, United States Topographical Engineers, a proposition to make a report upon the geographical and topographical features of the region which he had traversed during the three preceding years. The knowledge thus obtained by Dr. Hayden was desired by the United States War Department that it might be made available by a party in charge of Lieutenant Warren, which the department was about to send out to the region then generally spoken of in connection with military operations as the Sioux country. Dr. Hayden at once accepted this proposition and set about preparing the report. Meantime Lieutenant Warren was preparing for his departure, and, having appointed Dr. Hayden as an assistant, they set out in the following May for "the exploration of the Yellowstone river from Fort Pierre to a point 60 miles north of the mouth of the Yellowstone."

Having accomplished its purpose the party returned, reaching Washington in November, 1856.

In the spring of 1857 Lieutenant Warren organized a party for exploring the region about the Black hills, and in May of that year Dr. Hayden was appointed as its geologist. The party started from Sioux City, Iowa, and proceeded westward to Loup fork of Platte river, following up its valley to the region of their special work. The return was made late in the same year, Dr. Hayden reaching Washington in December.

The summer of 1858 was spent by Dr. Hayden and Mr. Meek in company, exploring various parts of the then Territory of Kansas. This exploration was very successful, especially in the collection of fossils, which were published under the names of Meek & Hayden, a joint authority which from that time forward became familiar to all readers of geological literature.

Early in 1859 Captain (afterward General) W. F. Reynolds, of the United States Topographical Engineers, was instructed to "organize an expedition for the exploration of the country through which flow the principal tributaries of the Yellowstone river, and of the mountains in which they and the Gallatin and Madison forks of the Missouri have their source." Dr. Hayden was appointed surgeon and naturalist of that expedition in April of that year, and leaving Saint Louis on May 28 the party proceeded up the Missouri river to Fort Pierre. From Fort Pierre they journeyed westward, and a part of the objects of the expedition was accomplished during that season. At the close of the season the party turned southward and went into winter quarters near the upper portion of the valley of the North Platte. Explorations were resumed in May of the following year, and in October the party reached Omaha on their return, where it was disbanded, and Dr. Hayden returned to Washington.

The outbreak of the civil war put an end to all western exploration and Dr. Hayden entered the Union Army. His first appointment was acting assistant surgeon, but he gradually rose to post surgeon, surgeon-in-chief of division of cavalry, and at the close of the war he was brevetted lieutenant colonel for meritorious services during the war.

In 1865 Dr. Hayden was elected Professor of Geology and Mineralogy in the University of Pennsylvania, and held that position for seven years, but an arrangement was made by which his duties

at the university were not to interfere with western explorations, his plans for the prosecution of which he had never abandoned.

In 1866 he made a second trip to the Bad Lands of Dakota, as they were then called, the later one being under the auspices of the Academy of Natural Sciences of Philadelphia. On this trip he reviewed many points exhibiting geological structure which had been previously visited by him, made notes of the same, and brought back large and important collections of fossil remains.

Upon the admission of Nebraska as a State, in 1867, Congress set apart five thousand dollars, an unexpended balance of appropriation for legislative expenses. This sum was devoted to a geological survey of the new State, and Dr. Hayden was placed in charge. In 1868 five thousand dollars more was appropriated, and he was authorized to extend his work westward into Wyoming Territory.

For the results of the explorations of these two years Dr. Hayden made his reports to the Commissioner of the General Land Office, but in 1869, Congress having made an appropriation for continuing the work in the territories, it was placed under the Secretary of the Interior, and Dr. Hayden was continued in charge. It was thus that what was afterward known as the United States Geological Survey of the Territories was begun.

The work for 1869 consisted of a reconnoissance by the whole party of ten persons along the eastern front of the Rocky mountains from Cheyenne to Santa Fé, and journeys by Dr. Hayden into Middle Park and Great Salt Lake basin.

The expedition of 1870 was organized in a similar manner to that of 1869, and the areas reconnoitered were a belt of country along the eastern base of the Laramie range, the upper valleys of the North Platte and Sweetwater rivers, besides portions of the Laramie plains, of the northern slope of the Uinta range, and of Green river basin.

The parties of the expedition of 1871 consisted in all of about thirty persons, including laborers. The organization of the expedition was similar to that of the previous year, except that two topographers were employed, but the work was mainly a reconnoissance, as that of all the previous expeditions had been. A portion of the region about the sources of Yellowstone river was explored, the outfit for the field having been made from Ogden, Utah, which was made practicable by the then lately constructed Union Pacific railway. The results of this season's exploration attracted the widest

interest, and Congress readily complied with Dr. Hayden's recommendation that the region he had last explored be set apart as a National Park. This plan was an original conception of Dr. Hayden and one for which he deserves unstinted credit.

The work of 1872 was far more systematic than that of any of the preceding years, a true geographical and topographical feature having been added to it. Two divisions were organized for field work, the first directing its labors mainly to the region which afterward became the National Park, and the second explored the region drained by Snake river, the southern great tributary of Columbia river. This party made important corrections in previously published maps.

In 1873 the work assumed a still more systematic form, and more men of scientific ability were added to the corps. Colorado was the field of operations, and three divisions were organized, one operating in Middle Park, one in South Park, and the other in San Luis Park.

The work of the survey for the years 1875 and 1876 was confined mainly to Colorado, its organization having been similar to that of the two preceding years. A large part of the work of 1877 was also done in Colorado, but two of the five field parties operated in a region comprising portions of Wyoming, Utah, and Idaho.

In 1878, appropriations having been reduced, parties of the survey operated only in the Yellowstone Park, Snake river and Wind river regions. This was the last year of the work organized by Dr. Hayden, it having been superceded by the organization of the present United States Geological Survey in the following summer.

While the explorations and surveys under Dr. Hayden were in progress other persons from time to time obtained appropriations from Congress for similar organizations, all of which operated independently of one another. The result was that a rivalry arose between them which was believed to be detrimental to science and the interests of the Government; consequently Congress determined to bring them all under one organization, and in 1879 all of them, including the one under Dr. Hayden, were disbanded and the present United States Geological Survey was organized.

In view of the extent, long duration, and success of Dr. Hayden's labors, he felt, as did a large proportion of his friends, that he ought to have been placed in charge of the new organization, and he and they were disposed to regard his retirement as an unjust reflection

upon him. He was then in the full possession of his physical and mental vigor and felt very keenly his forced retirement from the executive prosecution of a work which he had established with so much labor and hardship and the expenditure of the best energies of his life.

When, however, the new organization was accomplished and another man placed in charge of it, he submitted without complaint and accepted a subordinate position upon the survey for the purpose of enabling him to complete certain portions of the work which he had begun. He retired to Philadelphia, where during the following four years he occupied himself with the work mentioned, making occasional journeys to the scenes of his early labors in the west.

Not long after his retirement it became apparent to his friends that his health was not so vigorous as formerly, but it was not until 1882 that alarming symptoms of the disease of which he died were manifested. His disease, locomotor ataxia, made its usual progress and at the end of the year 1886 he voluntarily severed his connection with the United States Geological Survey, thus ending nearly thirty years of honorable service to the Government as naturalist, geologist and surgeon.

An account of Dr. Hayden's official career is practically the story of his life during that time, and I am able to add comparatively little to the foregoing narrative besides some references to his domestic life and his personal characteristics.

On November 9, 1871, he was married to Miss Emma C. Woodruff, daughter of Edward D. Woodruff, a well known merchant of Philadelphia. During his directorship of the United States Geological Survey of the Territories they lived quietly at Washington, but upon his retirement they went to live in Philadelphia. No children blessed this union, but their devotion to each other was of the most sincere and earnest kind.

After his resignation from the survey Dr. Hayden's health failed rapidly and it soon became apparent that his end was rapidly approaching. A recent letter to me from Mrs. Hayden contains the following touching statement concerning his condition during the last year of his life: "During the year, with the exception of two months in the summer, when he was carefully taken in a carriage for a visit to Bryn Mawr, he was confined to his room. His library was utilized for his greater comfort, and here he sat so helpless as

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to require the constant attention of a man-servant, but thankful that he could always hold his books and that he was able until the last to use his eyes. Those who visited him there felt that it was a never-to-be-forgotten scene. The unusual sweetness and cheerfulness of his nature, united with a marvelous strength of self-control, were never more strongly marked. Speaking but little of himself, his pain, or of the disappointment at the loss of his active life, he was ever ready with a cheerful greeting to his old friends, taking the greatest interest in literary matters of the day and in the affairs of the world, from which he seemed shut away."

He died on December 22, 1887, and his body lies buried in Woodland Cemetery, in West Philadelphia. His monument is an unpretentious one of granite, surmounted by a conventionalized Greek cross, with a circle, below which is the following inscription :

FERDINAND V. HAYDEN, M. D.,
Died December 22nd, 1887.

Below this is a space reserved for Mrs. Hayden's name, and beneath that space is the motto :

Fide et Amore.

My long personal acquaintance with Dr. Hayden entitles me to say something of his personal qualities, but I prefer to quote and endorse the expressions of a few others of his friends. Dr. A. C. Peale says of him : "The apparent diffidence which impressed Dr. Hayden's fellow-students at Oberlin and led them to be doubtful as to his future course in life characterized his maturer years, and to those not well acquainted with him made it difficult to account for his success. However, enthusiasm, perseverance, and energy were qualities equally characteristic of him all his life, and what seemed to be diffidence was largely the result of his nervous temperament. The secret of his success is to be found in his enthusiastic frankness and his energetic determination to carry through whatever he undertook. He was absorbed in the work of the Geological Survey and bent all his energies to its success. Excitable in temperament and frequently impulsive in action, he was generous to a fault, and although ever ready to defend what he believed to be right he stood ready upon the presentation of evidence to modify his views.

“He was always careful to give due credit to all who had worked in the fields he afterwards explored. In one of his reports, speaking of those who had preceded him, he says: ‘Any man who regards the permanency or endurance of his own reputation will not ignore any of those frontiersmen who made their early explorations under circumstances of great danger and hardship.’

“The same spirit actuated him in his treatment of his subordinates and coworkers. His honesty and integrity were undoubted and his work for the Government and for science was a labor of love.”

Sir Archibald Geikie, Director of the Geological Survey of Great Britain, in a sketch which he published in “Nature” says: “There can be no doubt that among the names of those who have pioneered in the marvelous geology of western North America that of F. V. Hayden will always hold a high and honored place. This place will be his due, not only because of his own personal achievements in original exploration. His earlier work exhibits much of that instructive capacity for grasping geological structure which is the main requisite for a field geologist. He had a ‘keen eye for a country,’ but he likewise possessed the art of choosing the best men for his assistants, and the tact of attracting them to himself and his corps. In this way he accomplished much excellent work, keeping himself latterly in the background so far as actual personal geological investigations were concerned, and contenting himself with the laborious task of organization and supervision, while he encouraged and pushed forward his coadjutors.”

Prof. J. P. Lesley, a member of this Academy, who had known him intimately for many years, paid the following tribute to his memory in a paper read before the American Philosophical Society: “He represented in science the curiosity, the intelligence, the energy, the practical business talent of the western people. In a few years they came to adopt him as their favorite son of science. He exactly met the wants of the Great West. There was a vehemence and a sort of wildness in his nature as a man which won him success, coöperation, and enthusiastic reputation among all classes, high and low, wherever he went. In the wigwam, in the cabin, and in the court-house he was equally at home, and entirely one with the people. He popularized geology on the grandest scale in the new States and Territories. He easily and naturally affiliated with every kind of explorer, acting with such friendliness and manly

justice toward those whom he employed as coworkers that they pursued with hearty zeal the development of his plans.

"In dealing with the public men of the country he was so frank, forcible, and direct that it was impossible to suppress or resist him. He had the western people at his back so heartily and unanimously that he was for a long time master of the scientific situation at Washington. He was a warm personal friend of some of the highest officials of the Government, who never failed to support strenuously and successfully his surveys."

The recognition of Dr. Hayden's services to science was so general that he was elected to membership in most of the scientific societies and academies of this country, and to about seventy of those of foreign countries. The degree of LL.D. was conferred upon him by the University of Rochester and the University of Pennsylvania; the former in 1876, and the latter in 1886. He was elected to membership in this Academy in 1873.

When a man has devoted his life to some special branch of science it is comparatively easy for some one to write an exhaustive and accurate estimate of the value of his labors, upon the basis of his published works; but the writings of Dr. Hayden alone do not afford the means of properly estimating the value of his services to science. He wrote no exhaustive treatises, but he made it possible for many others to prepare and publish such, and the scientific reputation of a considerable number of men was largely accomplished by means of the opportunities which he created. Nearly fifty persons whose names have become known to science were from time to time more or less directly connected with the surveys under his direction, no less than thirteen of whom are, or were when living, members of this Academy.

I do not by any means intend to intimate that Dr. Hayden's published writings and his observations in the field are of an inferior kind. Indeed, no geologist can fully review his work without being impressed with the accuracy of many of his generalizations, the fewness and unimportance of his mistakes, and the number of instances in which he anticipated opinions concerning the import of facts which he observed, which have been advocated by others. These facts will be all the more impressive if considered in connection with the wild and difficultly accessible character of the country which he traversed, the necessarily short time which during each journey he could devote to investigation in the field, and the gen-

eral condition of geological science at the time he began his work. There is, in my opinion, no room for doubt that the labors of Dr. Hayden, directly or indirectly, accomplished more for the general advancement of geological science in America than those of any one else. Indeed, I think it may be truthfully said that the present United States Geological Survey is a consequent of his labors, and that it would not now be in existence if Dr. Hayden's work had remained unaccomplished.

For the reasons just referred to a bibliographical list of the writings of Dr. Hayden is quite inadequate as an index to the work which he actually accomplished. I think, however, it is appropriate that I should give at least a partial list, one which shall include the titles of such of his own writings as are not contained in the different series of official publications of the surveys which were under his direction. I therefore present the following list:

A PARTIAL LIST OF THE PUBLISHED WRITINGS OF
DR. F. V. HAYDEN,

WITH GENERAL REFERENCES TO ALL THE OTHERS.

1. Explorations under the War Department. Notes explanatory of a map and section illustrating the geological structure of the country bordering on the Missouri river, from the mouth of Platte river to Fort Benton, in lat. $47^{\circ} 30'$, long. $110^{\circ} 30' W$. (Communicated by permission of the Secretary of War.) Proc. Acad. Nat. Sci. Phila., vol. ix, pp. 109-116. Philadelphia, 1858. Also issued as separates.

2. Notes on the geology of the Mauvaises Terres of White river, Nebraska. Proc. Acad. Nat. Sci. Phila., vol. ix, pp. 151-158. Philadelphia, 1858.

3. Explorations under the War Department. Explanation of a second edition of a geological map of Nebraska and Kansas, based upon information obtained in an expedition to the Black hills, under the command of Lieut. G. K. Warren, Top. Engineer, U. S. A. Proc. Acad. Nat. Sci. Phila., vol. x, pp. 139-158. Philadelphia, 1859. Also issued as separates.

4. Tertiary basin of White and Niobrara rivers. Am. Jour. Sci., vol. xxvi, pp. 404-408. New Haven, 1858.

5. Geological sketch of the estuary and fresh-water deposits of the Bad Lands of the Judith, with some remarks upon the surrounding formations. Am. Phil. Soc. Trans. Phila., vol. xi, pp. 123-128. Philadelphia, 1859.

6. Notes on the geology of Nebraska and Utah Territory (in a letter to one of the editors). Am. Jour. Sci., vol. xxix, pp. 433, 434. New Haven, 1860.

7. Sketch of the geology of the country about the headwaters of the Missouri and Yellowstone rivers. Am. Jour. Sci., vol. xxxi, pp. 229-245. New Haven, 1861.

8. The primordial sandstone of the Rocky mountains in the north-western Territories of the United States. Am. Jour. Sci., vol. xxxiii, pp. 68-79. New Haven, 1862. Also issued as separates.

9. Physics and hydraulics of the Mississippi river. Am. Jour. Sci., vol. xxxiii, pp. 181-189. New Haven, 1862. This article is a review of Humphreys and Abbott's report on the physics and hydraulics of the Mississippi river. Also issued as separates.

10. Some remarks in regard to the period of elevation of those of the Rocky mountains near the sources of the Missouri river and its tributaries. *Am. Jour. Sci.*, vol. xxxiii, pp. 305-313. New Haven, 1862. Also issued as separates.

11. Colorado river of the West. *Am. Jour. Sci.*, vol. xxxiii, pp. 387-403. New Haven, 1862. This article is a review of Lieut. J. C. Ives' report upon the Colorado river of the West. Also issued as separates.

12. A sketch of the Mandan Indians, with some observations illustrating the grammatical structure of their language. *Am. Jour. Sci.*, vol. xxxiv, pp. 57-66. New Haven, 1862. Also issued as separates.

13. Contributions to the ethnography and philology of the Indian tribes of the Missouri valley. *Am. Philos. Soc. Trans.*, vol. xii, pp. 231-461, 1 map and 2 plates of illustrations. Philadelphia, 1862. Also issued as separates.

14. On the geology and natural history of the upper Missouri. *Am. Philos. Soc. Trans.*, vol. xii, pp. 1-218, and map. Philadelphia, 1862. Also issued as separates.

15. [Remarks on a visit to the great Red Pipestone quarry.] *Am. Philos. Soc. Proc.*, vol. x, pp. 274, 275. Philadelphia, 1866.

16. [Description of a chalk deposit in the valley of the Missouri river.] *Am. Philos. Soc. Proc.*, vol. x, p. 277. Philadelphia, 1866.

17. [Remarks upon the geology of the Missouri valley.] *Am. Philos. Soc. Proc.*, vol. x, pp. 292-296. Philadelphia, 1866.

18. [Remarks upon the Lignite beds of the country of the upper tributaries of the Missouri.] *Am. Philos. Soc. Proc.*, pp. 300-307. Philadelphia, 1866.

19. Sketch of the geology of northeastern Dakota, with notice of a short visit to the celebrated Red Pipestone quarry. *Am. Jour. Sci.*, vol. xliii, pp. 15-22. New Haven, 1867. Also issued as separates.

20. [Scarcity of timber in certain parts of the upper Missouri river region.] *Am. Philos. Soc. Proc.*, vol. x, pp. 322-326. Philadelphia, 1869.

21. [Geographical distribution of plants in the region west of the Mississippi.] *Am. Philos. Soc. Proc.*, vol. x, pp. 315-320. Philadelphia, 1869.

22. Remarks on the Cretaceous rocks of the West, known as No. 1, or the Dakota group. *Am. Jour. Sci.*, vol. xliii, pp. 171-179. New Haven, 1867. Also issued as separates.

23. Notes on the geology of Kansas. *Am. Jour. Sci.*, vol. xlv, pp. 32-40. New Haven, 1867. Also issued as separates.

24. [Observations concerning the Indians of the lower Missouri river region.] *Am. Philos. Soc. Proc.*, vol. x, pp. 352, 353. Philadelphia, 1867.

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25. [Results of geological exploration in Nebraska.] Report of the Commissioner of the General Land Office for the year 1867, pp. 128-131. Gov't Printing Office, Washington, 1867.

26. Rocky Mountain coal beds. *Am. Jour. Sci.*, vol. xlv, pp. 101, 102. New Haven, 1868.

27. Notes on the Lignite deposits of the West. *Am. Jour. Sci.*, vol. xlv, pp. 198-208. New Haven, 1868.

28. [Remarks on the Pawnee, Winnebago, and Omaha languages.] *Am. Philos. Soc. Proc.*, vol. x, pp. 389-421. Philadelphia, 1869.

29. Remarks on the geological formations along the eastern margin of the Rocky mountains. *Am. Jour. Sci.*, vol. xlv, pp. 322-326. New Haven, 1868.

30. Remarks on the possibility of a workable bed of coal in Nebraska. *Am. Jour. Sci.*, vol. xlv, pp. 326-330. New Haven, 1868.

31. Notes on the geology of Wyoming and Colorado Territories, No. 1. *Am. Philos. Soc. Proc.*, vol. x, pp. 463-478. Philadelphia, 1869.

32. Geological explorations in Wyoming Territory. Report of the Commissioner of the General Land Office for the year 1868, pp. 229-235. Gov't Printing Office, Washington, 1868.

33. Report on the geography of the Missouri valley. Report of the Commissioner of the General Land Office for the year 1868. Gov't Printing Office, Washington, 1868.

34. Notes on the geology of Wyoming and Colorado Territories, No. 2. *Am. Philos. Soc. Proc.*, vol. xi, pp. 25-56. Philadelphia, 1869.

35. A new species of Hare from the summit of Wind River mountains. *American Naturalist*, vol. iii, pp. 113-116. Salem, 1869.

36. On the geology of the Tertiary formations of Dakota and Nebraska. Dr. Joseph Leidy's Extinct Mammalian Fauna of Dakota and Nebraska, pp. 9-21, and map. Lippincott, Philadelphia, 1869.

37. Geological report of the exploration of the Yellowstone and Missouri rivers under the direction of Capt. W. F. Reynolds, Corps of Engineers, 1859-'60. 174 pp. and map. Gov't Printing Office, Washington, 1869.

38. Sections of strata belonging to the "Bear River Group," near Bear River City, Wyoming Territory. *Am. Philos. Soc. Proc.*, vol. xi, pp. 420-425. Philadelphia, 1870.

39. Preliminary field report of the United States Geological Survey of Colorado and New Mexico. *Am. Jour. Sci.*, vol. xlix, pp. 258-263. New Haven, 1870.

40. Sun pictures of Rocky mountain scenery, with a description of the geographical and geological features and some account of the resources of

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the Great West, containing 30 photographic views along the line of the Pacific railroad from Omaha to Sacramento. 4to, 150 pp. and 30 photographic plates. Julius Bien, New York, 1870.

41. Final report of the United States Geological Survey of Nebraska and portions of the adjacent Territories, made under the direction of the Commissioner of the General Land Office. 8vo, pp. 264, 1 map and 11 plates. Washington, 1872. (The volume is in large part paleontological, that work having been done by F. B. Meek.)

42. The hot springs and geysers of the Yellowstone and Firehole rivers. *Am. Jour. Sci.*, vol. iii, pp. 105-115, and maps. New Haven, 1872.

43. Die neu entdeckten Geyser-Gebiete am Yellowstone und Missouri River. Nach dem officiellen Bericht von F. V. Hayden; mit Karten und Ansichten. Dr. A. Petermann's Mittheilungen, 18 Band, Seiten 241-253, 1 Tafel. Gotha, 1872.

44. The wonders of the West. More about the Yellowstone. *Scribner's Monthly Magazine*, vol. iii, pp. 383-396. New York, 1872.

45. The Yellowstone National Park. *Am. Jour. Sci.*, vol. iii, pp. 294-297, and map. New Haven, 1872.

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52. [Progress of the United States Geological Survey under the direction of Prof. F. V. Hayden.] *The Republic*, a monthly magazine, for December, 1877, pp. 217-226. Washington, 1877.

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57. [Letter to Hon. Carl Schurz, Secretary of the Interior.] Letter from the acting president of the United States National Academy of Sciences, transmitting a report on the surveys of the Territories. House of Representatives Mis. Doc. No. 5, pp. 11-13.

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60. Stanford's compendium of geography and travel, based on Hellwald's "Die Erde und ihre Volker." North America. Edited and enlarged by Prof. F. V. Hayden, late Chief of the United States Geological Survey, and Prof. A. R. C. Selwyn, F. R. S., Director of the Geological Survey of Canada. 652 pp., 17 plates, and 16 maps. London, 1883.

All the other known published writings of Dr. Hayden are contained in the following series of official reports: Annual Reports of the United States Geological Survey of the Territories, 1st to 12th, inclusive, 8vo; the quarto series of the same, vols. i to xiii, inclusive, except vol. iv, not published; bulletins of the same and miscellaneous publications of the same; also the annual reports of the present United States Geological Survey.

There are also omitted from the foregoing list all the publications which have appeared under the joint names of F. B. Meek and F. V. Hayden, a full list of which has been published in Bulletin No. 30 of the United States National Museum.