

*Celebrating the 100th Anniversary
of the
USDA's ARS Fort Collins Water Management Research Unit*

**Elwood Mead's Role in Founding CSU's and USDA's
Fort Collins Irrigation Programs**

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The U.S. Department of Agriculture's (USDA) Fort Collins Irrigation Investigations group and Colorado Agricultural College's initial water programs are, today, represented by the USDA Agricultural Research Service's (ARS) Water Management Research Unit and Colorado State University's Civil and Environmental Engineering Department's water programs. Since the beginning of these two irrigation organizations in the late 1800s, each, separately and together, has constructed a rich and continuous tradition of contributions to water research, education, and outreach. 2011 presents an opportunity to pause and reflect upon the history of these two, highly inter-related, water programs as it was 100 years ago that the USDA's Fort Collins Irrigation Investigations group was officially organized (AEXS box 28, 1911).

Why consider the origins of both organizations together? The roots of each have a common beginning in one man – Elwood Mead. Colorado Agricultural College provided Mead with initial knowledge, experience, and insight in western water management that matured into a public service career which included time with the USDA. At the same time, Mead put the college in Fort Collins on a path to excellence in water resources that continues to this day. At what is today Colorado State University, in the 1880s, Mead served as the first professor of irrigation engineering in the United States. At the USDA between 1899 and 1907, Mead fostered creation of the national Irrigation Investigations network where USDA irrigation investigators would cooperate with the agricultural colleges and experiment stations throughout the nation ‘..to gather and disseminate information primarily of interest to the small irrigator’ (Kluger, 1992, page 28). This organizational effort on the part of Mead led, in 1911, to formal creation of an irrigation investigations unit in Fort Collins associated closely with Colorado Agricultural College's Agricultural Experiment Station.

Mead (1858-1936) was born and raised in Switzerland County, Indiana, about 40 miles downstream of Cincinnati, Ohio, and within miles of the Ohio River. He grew up on the family farm and had access to a large library owned by his grandfather. In 1878 he entered four-year-old Purdue University where he worked his way to a degree in agriculture and science. While at Purdue he studied under Dr. Charles Lee Ingersoll in the School of Agriculture, who arrived at Purdue in 1879 and was particularly interested in a stronger connection between the theoretical and the practical - i.e., a closer link between the classroom and the farm (Kluger, 1992).

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Mead graduated in June 1882 and spent seven months as an assistant engineer with the Army Corps of Engineers in Indianapolis. During this time, Ingersoll became the second president of Colorado Agricultural College in Fort Collins. Mead married Florence S. Chase on December 20, 1882, and then departed for Fort Collins where Ingersoll had persuaded him to accept a position as professor of mathematics and physics (Kluger, 1992).

The newlyweds arrived in Fort Collins to find a town with a population of just over 2,000. The college had begun admitting students in 1879, three years after Colorado became a state (Corey, 1977). The Cache la Poudre River flowing out of the Rocky Mountains just to the west provided water for Fort Collins and downstream towns as well as for the arid agricultural lands. Mead was intrigued by the many irrigation ditches he saw lacing the land to move river water to farmland, as this was new to the farm boy from the humid East. To pursue this interest, he soon began assisting state engineer E. S. Nettleton, newly appointed as the second such officeholder in April 1883, with water distribution monitoring in the Fort Collins area (Kluger, 1992).

Mead likely was unaware before his arrival of the significance of the Poudre Basin to Colorado's water laws and administration. It was at the eastern end of the river, where it joins the South Platte, that the Union Colony had been established in 1870. There began large-scale irrigation, the first in the West after the Mormons in Utah. After the colonists built their irrigation ditch diverting from the Poudre River, like-minded farmers followed suit, building larger and larger ditches, always upstream. By the mid-1870s, this competition for water and a dry spring combined to cause Fort Collins and Greeley—after a dispute—to agree to the principle of prior appropriation, being that first use of water would guarantee first right to it. Colorado's 1876 constitution put this practice into statewide law, and within three years an administrative system was established which began with ten water districts. Two years later the State Engineer's Office was created to provide official oversight of water rights, and water divisions were established as well. Colorado became a leading state in irrigation laws and administration, mostly as a result of conflicts occurring in the region Mead was making his home (Kluger, 1992).

Quoting Kluger (1992) regarding Mead's introduction to western water issues:

“Mead's only official contact with these regulations was as a part-time watershed engineer in Larimer County. At the same time, he was also assisting President Ingersoll and Professors A. E. Blount and James Cassidy in the organization of an agricultural experiment station for the community. These two activities complemented one another, as this locale essentially was devoted to irrigated farming. This stirred Mead's interest in the whole issue of water rights in arid areas, and came to occupy increasing amounts of his time away from his teaching duties. His primary responsibility, however, was in the classroom.”

At the fledgling college with fewer than 100 students, the small faculty had to teach a variety of courses; Mead's included mathematics and physics. A portion of the physics course included instruction on the measurement and flow of water for irrigation, but Mead must have wished for more. In his annual report for 1883, he duly reported on his classes, but also encouraged the college to progress toward irrigation instruction (Mead, 1883):

“While it is not yet desirable that we institute any systematic course of instruction in engineering, it is highly important that our students have a knowledge of such engineering subjects as have a direct bearing on the subject of irrigation. From the character of the agriculture of this state, the obligation resting on this college to furnish some such instruction is peculiarly great, and its worth to our students and the state at large of corresponding value. Every farmer in Colorado has to apply some of the principles of engineering in the construction and management of his irrigating canals. The subject of the measurement and distribution of water is of great and constantly increasing moment, and it is in the highest degree important that our students be informed as to the principles which govern its flow.”

Mead returned east sometime in 1884. He had managed to earn a civil engineering degree from Iowa Agricultural College in 1883 and later, in 1888, a Master of Science from Purdue.² He joined his father-in-law’s legal practice briefly, but by July 1885 returned to Colorado because of his health (Fort Collins Courier, July 2, 1885). He resumed work with the state engineer, and when Colorado Agricultural College’s board created a chair of physics and irrigation early in 1886, Mead was elected to fill it beginning in fall 1886 (SBA annual report, 1885/86, p. 14). This was the first such position in the country. Mead’s background in agriculture, engineering, teaching, and law provided the basis for the rest of his highly successful career (Kluger, 1992).

Thus, Mead spent the next several years with two jobs – teacher (during the academic year) and assistant state engineer (during the summer). This combination permitted him to devote all his energies to ‘the study of all the physical, human and legal problems of turning on water with a shovel’ (Kluger, 1992, page 11).

In his classes, Mead introduced students to the history of irrigation by studying the water laws of other countries. His students were also introduced to canal building, evaporation, water measurement, and the duty of water. Hansen (1977, page 70) points out that Mead appeared to fully grasp the historical implications of his work in the following quote from Mead while he was a professor at Colorado Agricultural College:

“In establishing the chair of Irrigation Engineering, the College has taken the initiative in what must soon be an important branch of industrial training in all technical schools of the arid region. In Europe, every country where irrigation is practiced has schools, supported and controlled by the State for the education of its irrigation engineers, in the majority of cases only admitting the graduates of these schools into its service. In the United States, while this College is the first to offer systematic training in the subject, two other industrial schools have since made it a prominent feature of their courses of study. In a country, however, where thirty-two millions of acres of otherwise valueless and unproductive land have been brought under cultivation through the art of irrigation, and where there yet remains two hundred and fifty millions susceptible of being thus reclaimed, the need of such training and the opportunities for usefulness open to those

² All sources cite 1884, but Purdue Board of Trustee Minutes of June 6, 1888, clearly state that a degree was recently conferred on Mead.

possessing it, either as farmers, citizens in ordinary walks of life, or as engineers, are too great to admit of doubt or question.”

During his summers he oversaw irrigation activities in the South Platte River Valley – a task that refined his understanding of the benefits and shortcomings of Colorado’s water management system. In particular, he examined a problem that was developing with the increasing power of ditch operators. The irrigators along the ditches referred to the ditch operators as ‘water barons,’ thus the issue was given the name ‘anti-royalty movement.’ Mead took on the case of the irrigators and explained his views in a widely disseminated pamphlet in 1887 (Mead, 1887a). He noted that when irrigation began, canal construction was a cooperative venture of irrigators where the land and water were connected. Soon, though, speculators saw money-making opportunities and began building canals, planning to secure water rights and therefore control land values to potentially make tremendous profits (Kluger, 1992, page 12).

Again quoting Kluger (1992, page 12), we see Mead’s concerns about the future of irrigation in Colorado:

“Such speculative activity discouraged immigration, Mead said, and hindered the development of Colorado. Besides, it created an intolerable burden on the farmers who held contracts with these companies. Echoing the words of Major John Wesley Powell, the first national figure concerned with the arid West, Mead stressed that ‘the right to use water should inhere to the land to be irrigated, and water rights should go with land titles.’ In this address, and in his travels throughout the state, Mead urged farmers to lend their influence to secure legislation favorable to guarding and protecting the interests of the actual user against a ‘water-right aristocracy.’

“Colorado enacted no additional water legislation while Mead was there, but in 1888 and 1889, the state Supreme Court declared that ditch companies were common carriers only, and the carrier could not become the proprietor of the water diverted. How much influence the young assistant state engineer had on these decisions cannot be ascertained, but their effect was to prevent the monopoly he warned against.”

Mead’s time in Colorado as professor and assistant state engineer clearly stimulated his interests and provided many research, speaking, and writing opportunities. Bulletin no. 1, titled “Report of Experimental Work in the Department of Physics and Engineering,” issued by the college in 1887 was by Mead. The college’s governing board had recently authorized the publication of reports concerning experiments conducted at the college. Mead wrote about experiments related to irrigation, meteorology, and the duty of water, in particular (Mead, 1887b).

Also in 1887, the federal government passed the Hatch Act, establishing agricultural experiment stations at the nation’s land-grant colleges. Colorado Agricultural College established theirs in 1888, with both Ingersoll and Mead involved (Fort Collins Courier, March 1, 1888).

All of these activities served to make Mead known widely as an authority on irrigation and water rights, even beyond the borders of Colorado. When neighboring Wyoming established a territorial engineer position in 1888, they offered Mead the job, which he accepted. During his

time in Fort Collins, he gained both theoretical and practical insight into western water management. At the same time, he responded to issues he saw needing education and research and organized responsive programs at Colorado Agricultural College. As he proposed solutions, there did not appear a response he felt the problems deserved. Thus, when Wyoming offered him the opportunity to create a new system of irrigation more along the lines he felt were required for enhanced western development, he embraced the challenge and the opportunity.

Mead would spend eleven years in Wyoming. During this time he used his knowledge to help Wyoming write the water sections of its constitution when statehood was achieved in 1890. As State Engineer, he then established the procedures by which the water-related portions of the new constitution would be implemented. Kluger (1992, pages 20-21) notes that by age 36:

“...Elwood Mead had made a significant contribution not only to the water laws of Wyoming but ultimately to all of the western United States, and indeed to arid regions around the world. The Wyoming Code and the administrative system he devised came to be known as the Wyoming System. It was the model for similar legislation in the rest of the arid American West. Its influence soon spilled across the border into Canada where it formed the basis of the water laws for that country’s emerging irrigation development. Ultimately, Mead’s ideas spread as far as the southern hemisphere, into Australia, New Zealand, and South Africa.”

During his years in Wyoming, Mead steadily increased his involvement in western and national water concerns and issues, furthering his national reputation and contacts. He was particularly active with the Wyoming delegation in Congress in pursuing legislation that would, in his mind, enhance economic development in Wyoming and the West through irrigation.

In 1897, Florence Mead died, leaving Mead with three children under the age of seven. About this time he began to realize he had exhausted professional opportunities in Wyoming and further advancement of the benefits of reclamation in the West would probably have to occur at the federal level. To be a part of such action at that level, Mead began to seek new opportunities. In 1898, he began working on some irrigation studies for the USDA. After legislation passed authorizing the USDA Office of Experiment Stations to engage in irrigation investigations, Mead resigned as Wyoming state engineer (Kluger, 1992) and was appointed head of USDA irrigation investigations in 1899.

In 1888, the U.S. Secretary of Agriculture created the Office of Experiment Stations under the USDA. That office became the coordinating link and clearinghouse for the land-grant institutions and their experimental research, as well as the home of irrigation investigations, beginning subsequent to the 1898 legislation. The legislation “appropriated ten thousand dollars for the purpose of collecting from agricultural colleges, agricultural experiment stations, and other sources including the employment of practical agents, valuable information and data on the subject of irrigation, and publishing the same in bulletin form.” Further legislation passed the following year added irrigation law investigations, and drainage studies were added in 1904 (Conover, 1924, page 89).

Kluger (1992, page 27) describes Mead’s time with the USDA:

“Between 1899 and 1907, Elwood Mead served as full-time expert-in-charge of irrigation investigations for the Office of Experiment Stations in the Department of Agriculture. The appointment put him on the national scene at a time when the federal government was moving toward direct involvement in reclamation. Mead’s opposition to large-scale federal action conflicted with influential advisors to President Theodore Roosevelt. He became the spokesman for a limited, states-oriented program, but his views did not prevail. After the passage of the Reclamation Act in 1902, Mead began to look for other professional opportunities. Nevertheless, he stayed with the Agriculture Department for five additional years. Meanwhile, he returned to the classroom, teaching part-time at the University of California, Berkeley.”

Before 1902, there had been recognition that the federal government was moving toward a larger role in reclamation in the West. The Agriculture and Interior departments vied to take the lead in the new federal role in irrigation. Each department had its own ideas of how this role should evolve, thus they both sought to be the lead agency for whatever federal program emerged from the impending legislation. Creation of an irrigation investigations arm of the USDA, led by Mead, was a part of the bureaucratic maneuverings leading up to passage of the Reclamation Act in 1902. Proponents of a limited federal role supported the irrigation approach with Mead at the head (Kluger, 1992, pages 27-28).

As head of irrigation investigations, Mead’s main focus, as it had been through most of his career, was on the application of water to land at the farm level. He remained close to the farmers by setting up initial headquarters for the investigations at Cheyenne, with a branch established later at Berkeley. Also, right from the beginning, Mead “established a series of observing points all over the country where irrigation is practiced” (Colorado Transcript, September 6, 1899). Inevitably Fort Collins, site of the state’s land-grant college and experiment station, was chosen as an observing point. Mead’s affection for the area may also have had something to do with it: “The irrigated district watered by the Poudre River of Colorado is not surpassed by any other in either the intelligence of its irrigators or the excellence of the methods employed in the distribution of water from the stream” (Mead, 1900, page 16).

As Kluger (1992, page 28) states, Mead realized early in his career:

“...irrigation farmers required specialized help and advice. He had begun to explore this need in Wyoming, where he induced a number of farmers to experiment with different crops and methods of irrigation. The mandates of his new federal job were to gather and disseminate information primarily of interest to the small irrigator. His duties included ascertaining the most economical use of water for the cultivation of different crops in various regions, analyzing soils and determining the fruits, grains, and vegetables that grow best under irrigation. Mead was also to examine the laws concerning water rights in the arid regions, to point out defects in them or their administration, and to assist farmers in securing and protecting their rights. *Agricultural colleges and experiment stations throughout the nation were to cooperate in carrying out these tasks.*” (emphasis added)

So Mead set in motion establishment of irrigation investigation ‘units’ at agricultural colleges – an action that led, in 1911, to formal establishment of such a unit at Colorado Agricultural College in Fort Collins.

Mead departed in 1907 for Australia, and Dr. Samuel Fortier became chief of irrigation investigations. He began a reorganization, in part because of the growth the division had experienced over the years and the need for an efficient field force, as well as to provide better assistance for farmers (Conover, 1924, page 92). This involved “placing an agent in charge of irrigation investigations in each State of the arid region.” As of 1910, ten state agencies had been established, with more to follow as funds were secured (USDA, 1911, page 37). With cooperative ties already established by Mead and the strength of the knowledge and faculty already there, a program was set up at the Colorado Agricultural Experiment Station in Fort Collins.

Interestingly, the president of the college when the cooperative agreement was established in 1911 was a man who had previously worked under Mead on irrigation investigations. Charles Lory, an Ohio native who had been in northern Colorado since 1888, helped his father irrigate as a teenager and later found employment as a ditch rider. In 1905, he came to Colorado Agricultural College to teach physics and by 1909 was president of the institution (Hansen, 1980).

In 1907, Mead invited Lory for a summer appointment with his Division of Irrigation and Drainage Investigations. Lory’s work was based in Wyoming, and he was assisted by Mead’s son, Tom. Mead and Lory kept in touch even after Mead left for Australia in fall 1907. They would eventually collaborate again, when Mead was at the Bureau of Reclamation and Lory was still college president, on the Colorado-Big Thompson trans-mountain diversion project (Hansen, 1980). Both Lory’s interest in water research and his predisposition toward Mead and the USDA’s irrigation investigations division may have contributed to the 1911 agreement (Duke, 2000, p.2).

The man brought in to be the first director of the irrigation investigations unit in Fort Collins was Victor M. Cone. Cone had been employed by the USDA since 1906 and was previously based in California. Under Cone, the Fort Collins USDA irrigation investigations staff addressed a number of key topics in their formative years, including water flow measurement, defining return flows, the duty of water, and quantifying evapotranspiration. In particular, between 1919 and 1926, USDA irrigation investigator, Ralph Parshall, conducted studies on a site located near the Jackson Ditch’s main diversionary headworks on the Cache la Poudre River, resulting in the development of a flume that revolutionized practical water flow measurement in the administration of water rights, not only the West, but around the world (Poudre Heritage Alliance, 2002, page 8). Parshall (1952) describes efforts of the USDA irrigation investigations unit to quantify irrigation return flows, during a celebration of the 100th anniversary of Colorado’s first water right appropriation date, San Luis People’s Ditch in the San Luis Valley. [More information on the USDA irrigation investigations unit staff and their contributions is available at <http://www.ars.usda.gov/npa/ftcollins/wmr>.]

By 1911 when the Fort Collins unit was formally established, Mead had been in Australia for four years trying to implement most of his ideas about reclamation. Australia, like the western U.S. when Mead arrived in 1882, was at that point in its development when they needed to develop water resources in which, given the arid nature of much of the country, irrigation would play a large role. It must have appeared to Mead that he had another “blank slate” upon which to continue to test his theories about the use of irrigation to develop a prosperous society, now using government-planned communities.

Mead travelled abroad several times while based in Australia and visited Fort Collins in both 1910 and 1912 (Fort Collins Weekly Courier, October 6, 1910 and August 30, 1912). Upon his permanent return to the United States in 1915, Mead assumed the position of professor of rural institutions, University of California, Berkeley, 1915-1923 and chairman of the State Land Settlement Board of California, 1917-1923. In 1924, Mead returned to federal service as the Commissioner of Reclamation, United States Department of the Interior, until 1936 (Hansen, 1977).

During the lead up to construction of Boulder Dam, and under Mead’s leadership, the Bureau of Reclamation stationed a Boulder Dam design team in Fort Collins to use the Irrigation Investigations Unit’s Hydraulics Laboratory to conduct studies. The Hydraulic Laboratory was constructed beginning in 1912 under the direction of Ralph Parshall, then a professor at the College, and Victor Cone, director of the USDA irrigation investigations unit which had offices on campus (Hansen, 1977). The USDA Hydraulics Laboratory was located where the north end of the Lory Student Center sits today.

Elwood Mead, while being a very quick study in irrigation engineering during the 1880s, put Colorado Agricultural College on a path toward water education, research, and outreach that is widely respected around the world today. The College instituted irrigation engineering as a distinct area of study in 1889 (one of four that existed at the time). What Mead began in the 1880s was firmly entrenched on campus by Louis G. Carpenter who joined the college as Mead’s replacement in 1888. Carpenter had studied under Ingersoll when both were at Michigan Agricultural College (the forerunner of Michigan State University) in the late 1870s.

Mead was also a quick study in the politics of irrigation law and policy which led him to involvement in national irrigation politics from 1899-1907. During this time he established the foundation of irrigation investigations that led to formation, in 1911, of an irrigation investigations unit in Fort Collins, in close association with the Agricultural Experiment Station at Colorado Agricultural College.

From this brief overview of Elwood Mead’s early career we see how the origins of what is today the USDA ARS Water Management Research Unit and the water programs in Colorado State University’s Civil and Environmental Engineering Department are very closely connected. These programs, while under going a number of name changes over the years, have also collaborated in highly productive ways, including educating future irrigation engineers.

It is, thus, very appropriate to note this close collaboration and include its richness and productivity during the 100th anniversary celebration of the USDA ARS Water Management Research Unit in 2011.

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