



THE REVOLUTIONARY CARTOGRAPHY OF HAL SHELTON

Shaded relief, natural colour, and ski area mapping

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In 1952 Richard Edes Harrison (1901–1994), one of the twentieth century's most renowned cartographers, described the work of artist and mapmaker Hal Shelton as 'magnificent in execution and conception'.¹ Forty-five years later, in 1997, Hal Shelton (1916–2004) was honoured by the Geography and Map Division at the Library of Congress as one of 'the four greatest living American mapmakers' along with Harrison, Arthur Robinson (1915–2004) and Marie Tharp (1920–2006).² I had admired Shelton's maps for years and had added several to my collection, so I was excited to attend this special event. After the programme, a small dinner was held for the honorees at which I was seated next to Hal and his wife. Among the crowd of easterners, we happened to live only twenty miles apart in Colorado and struck up a friendship.

As I had researched Hal's cartographic work, including having made several visits to his home in the town of Golden, just on the edge of the Rocky Mountains, it became clear why the Library of Congress was so keen to honour him. Shelton had done groundbreaking work in three different genres of cartography: shaded relief, natural colour, and ski area maps. This paper describes his career and the different types of maps he produced.

After earning a degree in scientific illustration from Pomona College in California, and unable to find a job as an artist during the Great Depression, in 1938 Shelton obtained a position as a surveyor with the United States Geological Survey (USGS). Although he spent most of his time creating maps in the field and at the drafting table, his artistic talents were soon discovered, and he was assigned to several special art projects for the USGS including a painting (Fig. 1) which still hangs in the regional office in California.

Fig. 1. Hal Shelton, *Cartographers in the Field*, 1940. The oil painting depicts mapping techniques used early in the 20th century, including an alidade and stadia rod for determining distances and elevations, and a plane-table for sketching contour lines. 8 x 1.2 m (6 x 4 ft). USGS office in Menlo Park, California.

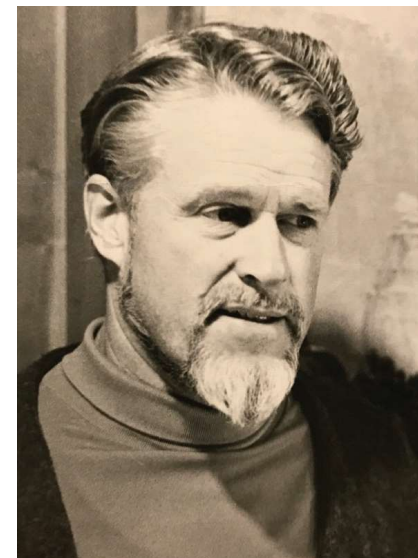


Fig. 2 Hal Shelton (1916–2004) pictured at prime working age. Library of Congress.

Shaded relief maps

Mapmakers who create shaded relief maps use special printing techniques and occasionally add colour to emphasise mountain slopes to create 'the effect of the third dimension for the map and rendering its larger features more understandable'.³ The technique is most successful for mapping mountainous areas where the terrain has considerable altitude differences. The idea for using shading to indicate slopes had been around since the 1800s; however, putting it into practice proved difficult. Baron Friedrich Wilhelm von Egloffstein (1824–1885), a brilliant German-trained cartographer working for the United States Army



Fig. 2 Frederick von Egloffstein, detail from 'Geological Map No 2, Rio Colorado of the West', 1861. 37 x 87 cm (15 x 34 in). The area was explored by 1st Lieut. Joseph C. Ives, Corps of Topographical Engineers in 1857–58. Author's collection.

Corps of Topographical Engineers was a forerunner of the technique. He accompanied 1st Lieutenant Joseph Christmas Ives on his 1857–58 expedition to explore the Colorado River and Grand Canyon area and produced a striking shaded relief map of the Grand Canyon. It was published in 1861 (Fig. 2). To demonstrate differences in altitude Egloffstein developed a technique to show topographic features from an oblique angle by illuminating one side and leaving the other dark. This was accomplished using a time-consuming process of etching extremely fine parallel lines (impossible to see with the naked eye) to the printing plate which created different intensities of grey rather than the traditional black ink on white paper. This approach had never been done, at least not by mapmakers in the United States. But it was prohibitively expensive and Egloffstein used the technique only once more for a map of expeditions and surveys of New Mexico and Utah.⁴

Early in the twentieth century, the US Secretary of the Interior requested a more artistic technique be employed for a special map series of the western national parks. John Renshaw (1852–1834), inspector of maps and accomplished watercolourist, adapted

existing topographic maps of the area by replacing the contour lines with gradations of colour to indicate relief. In 1913 the USGS began publishing Renshaw's maps which included Crater Lake (1913), Yosemite (1914), Glacier (1914), and Yellowstone (1915) along with one or two a year thereafter. The practice was discontinued in 1928 when it too was deemed too expensive (Fig. 3).⁵

In Europe, Eduard Imhof (1895–1986), Professor of Cartography at the Swiss Federal Institute of Technology, began developing these techniques in the 1930s; but in the United States, shaded relief maps were no longer produced. And this is where Hal Shelton comes into the story. How did Shelton get the idea for shaded relief maps? He described the momentous event to me: In the early 1940s, after preparing a draft quadrangle map⁶ in a remote part of Nevada, he went into town to ask the locals for the names of the various geographic features in their area. As was standard for USGS, the map he had created

Fig. 3 John H. Renshaw, USGS, 'Panoramic View of the Yellowstone National Park, Wyoming-Montana-Idaho', 1915. 53 x 46 cm (21 x 18 in). Scale: 1:187 500. Author's collection.



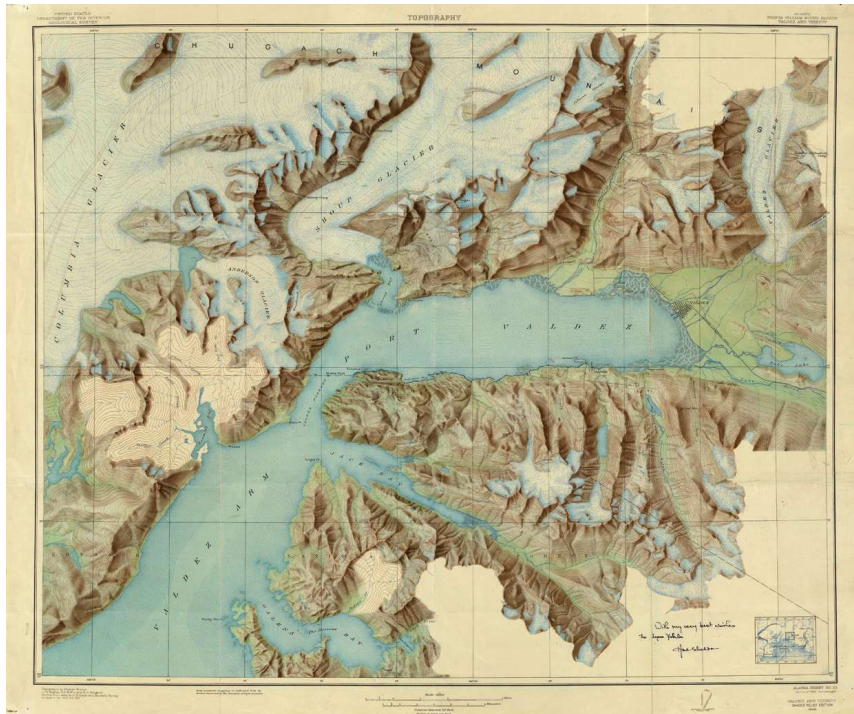


Fig. 4 Hal Shelton, shaded relief map of the Prince William Sound region, Alaska, titled 'Valdez and Vicinity', 1948. 63 x 75 cm (25 x 30 cm). Scale: 1:62 500. USGS. Author's collection.

used contour lines to illustrate the topography. When he asked residents to tell him the name of a mountain he had pointed out on the map, they did not recognise the narrowing lines as a mountain because they did not understand contour lines. However, when Hal pulled out a pencil and started shading in the mountain's features, the group immediately declared, "Oh, that's Deer Mountain". The experience prompted him to urge USGS senior management in Washington to create a new kind of map that could be easily understood by the average user. His request benefitted from recent events. During World War II, the War Department had made some shaded relief maps for a few key military objectives. These proved very popular with the troops, so it was agreed to try and produce similar maps for civilian use. Hal was assigned to start the project in 1946.

It is no surprise that for one of his earliest efforts he chose the dramatic landscape of the Prince William Sound in Alaska. Its spectacular topography is noted for its mountains which tower to elevations of over 1,524 m (5,000 ft) and plunge to sea level in less than 3 km (2 miles) and glaciers that scour valleys in their slow descent to the sea (Fig. 4). 'Valdez and Vicinity' was published in 1948. It is based on a traditional 1930s 1:62 500 scale topographical map with standard contours at 15 m (50 ft) intervals. Figures 5a and 5b are details taken from Shelton's 1948 map and from the 1930 map. Most observers find that Shelton's map better illustrates the dramatic topography even though some technical information is lost. For the untrained eye the technique produces a map that is much easier to understand.

Shelton was immensely proud of this map and kept

it as a trophy for decades. Near the end of his life he signed the map and gave it to his close friend and colleague at the USGS, Lynn Yehle (1929–2019), a specialist in glaciation who worked in the Denver office.

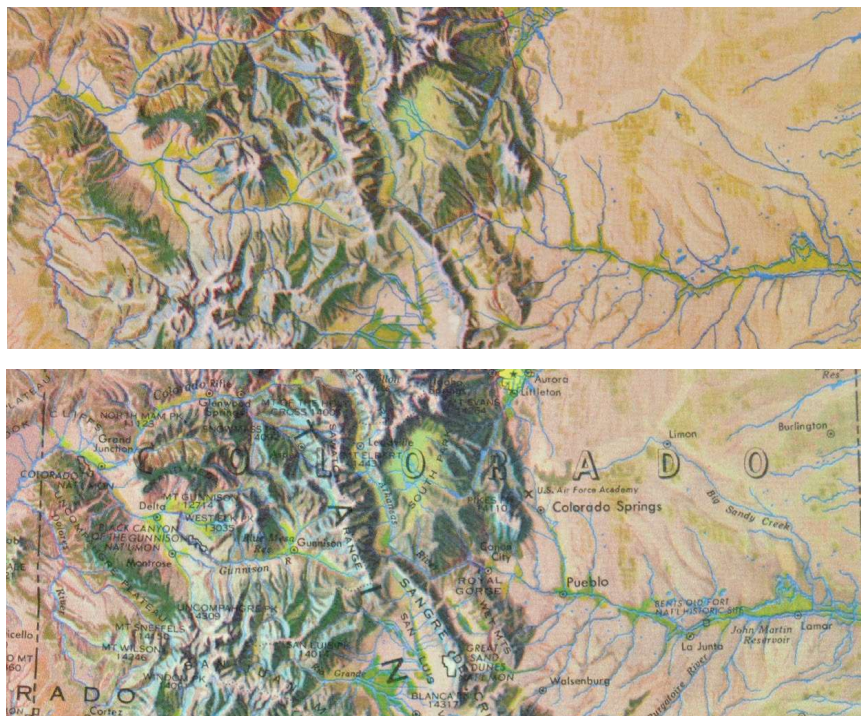
Although the expense of printing shaded relief maps was only marginally more than printing traditional USGS maps, the cost of creating them was high. The techniques Shelton used at the time required months of work to produce a single map. Of the thousands of USGS quadrangle maps published using contour lines, only a very few were prepared using this elaborate method. For example, of the hundreds of individual USGS produced topographical map sheets of Colorado, only four employed shaded

relief. In addition to one map of the entire state (1957), the other quadrangles were of the Rocky Mountain National Park (1963), Pikes Peak and Vicinity (1956), and Denver Mountain Area (1948). The costly technique was reserved for those mountainous landscapes which made the best use of shaded relief.

As noted earlier, Shelton was not the first to use shaded relief, but he deserves credit for refining the technique and restarting the USGS shaded relief mapping programme. It would continue beyond his leadership, producing about ten such maps per year. As a result of greatly improved production processes, they were still being made by the USGS into the twenty-first century.



Figs 5a and 5b Details of the Valdez quadrangle in the Prince William Sound area showing the difference between Shelton's 1948 shaded relief map (Fig. 5a) and the standard contour map (Fig. 5b) on which he based it. Author's collection.



Figs 6a and 6b The top image is a detail of a natural colour relief map of Colorado (1968) painted by Hal Shelton. The lower image is a detail of the same geographical area showing the additions of toponyms made by the publisher The H. M. Gousha Company to Shelton's painted landscape. Original proof in author's collection.

Natural colour maps

A few years after establishing the shaded relief operation Shelton started experimenting with classical landscape painting techniques in an attempt to represent the land in its natural colour. He tried various media and found that zinc plates were the most successful. After the painting of the terrain was complete, the publisher added features such as roads and toponyms in black or coloured ink (Fig. 6b). With special maps in mind Shelton proposed this new painting approach to the USGS management in Washington, but it was rejected. He resigned in 1949.

After a chance meeting with Denver-based pioneer pilot and aviation map and chart publisher Captain Elrey B. Jeppesen (nickname Jepp), Hal joined Jeppesen & Co.

Jeppesen knew that aviators needed to better understand the apparently flat terrain and invited Shelton to the firm's commercial art studio. Shelton recounted his visit: "There were two or three artists trying to make a map. Jepp said he wanted passengers to enjoy their flight and part of that was to be able to recognise the terrain they were flying over; the artists were attempting to do that." After the two men left the building, Jepp asked Shelton what he thought about the illustrators' work. He replied, "They are very good commercial artists, but they are not equipped to do this particular thing." Jepp then asked Shelton if he would produce a few sample drawings

Fig. 7 Hal Shelton, natural colour relief map of North America, c. 1968. 79 x 60 cm (31 x 24 in). Signed by Shelton. Author's collection.



– strip charts – of the route between Denver and the West Coast that realistically depicted the hills, rivers, forests, mountains, highways and cities as they would look from the air. Shelton agreed and captured Jepp's brief perfectly.⁷

Unlike Imhof, who used colour to emphasise elevation differences, 'Shelton felt that whatever existed on the ground mattered as much as its altitude and [therefore he] adjusted the colour of the terrain to reflect the nature of the surface'.⁸ He used various shades of green for vegetation and brown for drier landscapes (Fig. 7). To make natural colour maps, Shelton etched faint guidelines of the topography on zinc plates which he overpainted with acrylic paint using an airbrush and very fine paint brushes (Nos 00 and 000).⁹ Using this technique was extraordinarily time-consuming. Writing about the Jeppesen Company, *Airlift* magazine (April 1960) noted, 'A skilled artist, faced with the job of getting mountains, rivers and highways shaded exactly right, does well if he completes one square inch per hour. Original artwork on the map of California took 1,500 man-hours'¹⁰ (Fig. 8).

Recognising in Hal Shelton an artist with an exceptional sense of terrain, cartographic skills and strong artistic talent, Captain Jepp showed his work to the president of United Airlines who thought Shelton's maps were far better than those publisher Rand McNally were supplying, and he gave Jeppesen an order. The technique took off. Airlines clamoured to buy Shelton's painted landscapes. From these they could print their own route maps. According to aviation map historian Ralph Ehrenberg, 'Shelton and Jeppesen dominated the American airline market for nearly three decades with about twenty airlines under contract'.¹¹ Rand McNally and arch competitor, The H. M. Gousha Company, were soon engaging the Jeppesen Company to have Hal produce natural colour topographic paintings for maps to be used in their atlases and for general non-aviation purposes.

Tom Patterson and Nathaniel Kelso point out that 'although made before the advent of satellites, the Jeppesen series proved so detailed and realistic that the National Aeronautics and Space Administration (NASA) used them to index photographs of the earth taken on early space missions'.¹²

Fig. 8 Hal Shelton, 'California', 1959, painted for Jeppesen & Co. Acrylic on paper-covered zinc. 168 x 66 cm (66 x 26 in). Shelton Collection, Geography and Map Division, Library of Congress.



Ski area maps

Although skiing gained some popularity during the 1930s (particularly in the eastern United States with Ivy League college kids), in the West, its roots were deep. In the late 1800s, in the high mining towns of Colorado and California, skiing was essential mountain transportation. The sport became modestly popular at dozens of minor ski hills during the 1930s. My father described using a make-shift rope tow hooked up to an automobile during this decade to ski the Berthoud Pass in Colorado.

World War II profoundly changed the sport when the military decided to create a unique force for combat in winter in harsh terrain – the 10th Mountain Division, based at Camp Hale in the central Colorado Rockies at 2,834 m (9,300 ft). The Army's only mountain division saw brief but brilliant action in Italy in the spring of 1945. After the War, the Division was deactivated, releasing thousands of ambitious young men who, with their training and love for the mountains, created new ski areas across the country and launched the industry.¹³ Early resorts like Aspen in Colorado and Mammoth Mountain in California, joined Sun Valley, Idaho, America's first destination

ski area which had been created in 1936. From the late 1940s to the early 1960s, dozens of ski areas were established across the country.

An early example painted by Shelton in about 1963 is the Alta Ski area in Utah, (Fig. 9). Founded in 1938, Alta was one of the earliest ski areas in western United States. Only 45 minutes from Salt Lake City and located on the eastern flank of the Wasatch Mountains, Alta collects massive volumes of snow as the eastward flowing moisture hits the uplifting mountains. If we look closely at Shelton's image, we can see that he painted every tree and used shadows to give the sense of slope. Ski runs on multiple aspects of the mountain were artistically situated so the skier could understand their connection in one glance. The stunning display was depicted under a blue sky with wispy white clouds.

In 1960 one of the Jeppesen natural colour images of Colorado painted by Shelton was adapted for use by Continental Airlines to show its routes to the major ski destinations. But Colorado Ski Country

Fig. 9 Hal Shelton, 'Alta [Ski Area] Utah', c. 1963. 40 x 58 cm (16 x 23 in). Author's collection.





Fig. 10 Hal Shelton, 'Colorado Ski Country USA', c. 1968. 73 x 100 cm (29 x 39 in). Shelton's ability to depict complex mountain chains spread over hundreds of miles featuring the ski areas of Colorado is evident in this image. It was used for years in posters, magazines and advertisements. Author's collection.

USA, the industry's trade association, needed something more appealing that would feature each of its members. Shelton, who always engaged in freelance work apart from Jeppesen, was commissioned to paint a large panoramic map highlighting each of its member ski areas. But how to highlight such a vast area spread over hundreds of miles and numerous mountain ranges? Studying dozens of USGS topographic maps, Shelton converted this information into a bird's-eye view image that was instantly applauded by the industry (Fig. 10). Colorado Ski Country USA used Shelton's painting for large posters which were distributed throughout the country. It was printed repeatedly in various magazines and displayed in bars as large, framed posters by the Coors Beer Company. Ralph Ehrenberg hung a print of it in his office while he was serving as Chief of the Geography and Map Division of the Library of Congress.

Shelton's mountainscape are reminiscent of the famous and beautiful panoramas of the Alps created by Austrian cartographer and artist Heinrich C. Berann (1915–1999). Shelton knew of Berann's work but chose a different colour palette and style.¹⁴ Panoramic views of large areas were necessary to promote the ski industry and to attract tourists to take ski vacations. They appeared in trade magazines and airline advertisements as well. What Berann did for the European ski industry, Shelton did for the North American.

Although maps showing hiking trails had been published since the late 1800s, only a few ski-route maps had made their way into print by the early 1900s in Europe. In the United States, maps of ski runs were first painted on large wooden signs located around the ski area as guides. As resorts became larger and more complex, the idea of small, cheap and disposable trail maps was developed. But how best to depict a complex multifaceted mountain topography, with various slopes, ridges, bowls, valleys, and ski runs all observed from one viewpoint? Shelton, with his feel for mountain terrain, demonstrated his expertise in painting this topography; and as a resident of Colorado, a cradle of the industry, he received some early commissions to try his hand at painting close-up images of mountains with gaps where the ski runs



Fig. 11 Hal Shelton, detail from the poster for the Vail Ski Area, Colorado. Published by Colorado Ski Country USA, c. 1965. 72 x 51 m (28 x 20 in). Author's collection.

could be superimposed. This was a task in which he excelled, and by the early 1960s, Shelton became the first ski area artist in the country.

His paintings were used not only for trail maps but also for promotional posters and keepsakes such as a 1965 poster of the Vail Ski area in Colorado (Fig. 11). Vail opened in late 1962. It had been founded by Pete Siebert, veteran of the 10th Mountain Division, who started work in the fledgling Aspen Ski area in 1946. His partner was Earl Eaton, an amateur prospector whose adventures through the mountains led him to discover Vail's ideal location. They brought in one hundred initial investors. Each received a *very* generous deal: \$10,000 not only bought an equity interest but the right to buy a lot at the base of the ski hill for \$250 plus four lifetime ski passes. At the time the last lot was exercised in 1986, it sold for \$675,000!¹⁵ Shelton also got a lifetime ski pass in addition to cash for his artwork.

As the young industry exploded in popularity owners and operators of other ski areas who admired Shelton's work ordered his paintings. The owner of the ski area would commission a painting, to which, on completion, they would add symbols for chairlifts and trail names. As owners of the rights to the artwork, they would make changes to the map to reflect developments in their area.

Shelton's maps were produced for ski areas around the country including Jackson Hole, Aspen, Mammoth Mountain, Winter Park, Sun Valley, and Purgatory. Having produced scores of paintings in the 1960s and 1970s, he eventually passed the torch on to other artists: the first was Bill Brown, who was followed by James Niehues, and most recently by Kevin Masten; all of them had worked in Colorado. According to Niehues, "Hal was such a good artist... One thing that really stayed with me from Hal: he said paint the trees and shadows as if you were down skiing [amongst] them; paint the colors [as if you were] on the ground, not as if you were in the plane."¹⁶

Conclusion

Shelton will be remembered for his impressive contribution to mapmaking. He made maps for the USGS in the late 1930s and 1940s where he led the department in the creation of shaded relief maps. From the 1950s through the 1970s, he worked with the Jeppesen Company (later owned by Times Mirror Company), where he painted natural colour maps. These were used for flight crews, airline flight guides, atlases and individual wall maps for the general public, and even NASA investigations. They were licensed to numerous airlines, The H. M. Gousha Company and Rand McNally & Co. During the 1960s and 1970s he freelanced as an artist making ski area maps for dozens of resorts. In addition, throughout his career and especially during his retirement, he was engaged as a fine art painter. Many of his landscapes won awards including *Study of Erosion-Navaho Creek* which won Best of Show in a regional art exhibition.

During his tenure as Chief of the Geography and Map Division of the Library of Congress, Ralph Ehrenberg became a serious fan of Shelton and his work. He understood his considerable contribution to cartography and ensured that Hal was recognised at the 1997 conference – 'Four Greatest Living American Mapmakers'. The Division's association with Shelton began in 1985 when it was donated 32 of Shelton's original acrylic-painted zinc plates by the Times Mirror Company (which had acquired the Jeppesen Company in 1961) and its subsidiary The H.M. Gousha Co.¹⁷ Other related items have been added, including Shelton's *Canyonlands*, a painted triptych of Millard Canyon, Utah.

Hal Shelton brought artistic talent, a keen sense of terrain, sophisticated cartographic understanding, and an inventive spirit to the business of mapmaking that has enriched the field. He had enormous feeling for the land and stated that a successful map allowed a person to 'smell the mountain and hear the wind'.¹⁸ His ability in painting the earth's topography with the detail and realism of satellite images requires our continued admiration.

Notes

1 Thank you to Professor Susan Schulten for bringing to my attention this correspondence from Richard Edes Harrison to renowned cartographer Erwin Raisz following a 1952 conference on surveying and mapping. (Richard Edes Harrison Collection, General Correspondence, Box 14, 9 August 1952, letter from Harrison to Raisz, Map and Geography Division, Library of Congress).

2 Geography and Map Division of the Library of Congress centennial

celebration held 20 and 21 November 1997 in the Library's Jefferson Building in Washington, D.C.

3 Richard T. Evans and Helen M. Frye, 'Shaded Relief Maps, History of the Topographic Branch (Division)', U S Geological Survey Circular 1341, p. 73.

4 The other map is titled 'Map of Exploration and Surveys in New Mexico and Utah made under the direction of the Secretary of War by Capt. J.N. Macomb Topl. Engrs. assisted by C.H. Dimmock, C Engr.'. Egloffstein produced this map during 1861 and it was finally published in 1876. The Civil War delayed the publication for fifteen years. This delay had a benefit as the striking chromolithography of the plates would not have been possible in 1861. For Egloffstein see I.J. Demhardt, 'Friedrich Wilhelm von Egloffstein, the Ives-expedition to the Grand Canyon (1857-58), and the first relief shaded maps of a portion of the United States', https://icaci.org/files/documents/ICC_proceedings/ICC2011/Oral%20Presentations%20PDF/E2-History%20of%20cartography%20and%20GIS%20science/CO-453.pdf—

5 Evans and Frye, p. 73.

6 A quadrangle map covers a rectangle space in a specific scale to a specified number of degrees of longitude and latitude. A common US Geological Survey map quadrangle spans 7.5 degrees of longitude and 7.5 degrees of latitude.

7 Terry Barnhart, *Capt. Jepp and the Little Black Book*, Superior, Wisconsin: Savage Press, 2007, pp. 153–54.

8 Alastair W. Pearson, 'Relief Shading', *The History of Cartography*, Vol. 6:2, Chicago: University of Chicago Press, 2015, pp. 1268–69.

9 Tom Patterson and Nathaniel Vaughn Kelso 'Hal Shelton Revisited: Designing and Producing Natural Color-Maps with Satellite Land Cover Data', *Cartographic Perspectives*, No. 47, Winter 2004, p. 5.

10 Barnhart, p. 154.

11 Ralph Ehrenberg, 'Airline Maps', *The History of Cartography*, Vol. 6:1, Chicago: University of Chicago Press, 2015, p. 37.

12 Tom Patterson, 'Hal Shelton', *The History of Cartography*, Vol. 6:2, Chicago: University of Chicago Press, 2015, p. 1396.

13 H. Benjamin Duke, Jr., 'Skiing Soldiers to Skiing Entrepreneurs: Development of the Western Ski Industry'. Unpublished manuscript, Denver Public Library, 1989, pp. 6–8.

14 Patterson and Kelso, p. 8.

15 Duke, p. 12.

16 Jasen Blevins, *The Man Behind the Maps: Legendary Ski Artist James Niehues*, Greater Seattle Area, Washington: Open Road Ski Company, 2019, p. 17.

17 Hal Shelton Manuscript Map Collection. Spans 1949 to 1966. Call number G3201.B7 coll S5. Geography and Map Division, Library of Congress, Washington, D.C. See: 'Times Mirror Company Gives the Library Innovative Maps Painted by Hal Shelton', *Library of Congress Informational Bulletin*, 44.23 (10 June 1985), p. 121, pp. 123–24.

18 Patterson and Kelso, p. 4.

Wes Brown has been a collector of old maps for forty years with special interest in the exploration and settlement of the West and Colorado from the sixteenth century to the twentieth. A Denver resident, he co-founded the Rocky Mountain Map Society in 1991, has served as the Co-Chairman of the National Map and Geography Society of the Library of Congress and is currently the International Chairman of IMCoS, responsible for organising the annual international symposiums. He is a frequent speaker at map and history conferences and has published many papers on maps. Wes fell in love with maps at age sixteen when using US Geological Survey maps for climbing mountains.