FORD WHITMAN HARRIS AND THE ECONOMIC ORDER QUANTITY MODEL

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Ford Whitman Harris first presented the familiar economic order quantity (EOQ) model in a paper published in 1913. Even though Harris's original paper was disseminated widely, it apparently was unnoticed for many years before its rediscovery in 1988. During this period much confusion developed over the origin of the EOQ model. This paper explores the early literature on this model and traces the evolution of the confusion. It also sketches the remarkable life of Harris, who made contributions as an engineer, inventor, author and patent attorney, even though he received no formal education beyond high school. Harris's original 1913 essay is reprinted following this paper.

PART I. AN EARLY CLASSIC OBSCURED: FORD WHITMAN HARRIS'S ECONOMIC ORDER QUANTITY MODEL OF 1913

While by the present methods of teaching, a knowledge of science in its present state of advancement is imparted very successfully, eminent and farsighted men have repeatedly been obliged to point out a defect which too often attaches to the present scientific education . . . *it is the absence of the historical sense and the want of knowledge of the great researchers upon which the edifice of science rests.*

Cajori (1899),
as quoted by
Jaffe (1957, p. *x*).

Although this quotation was directed toward the field of physics at the turn of the century, recent discussions by Miser (1989a, b) and others suggest that it may apply equally well to our own field of Operations Research at the present time. The origins of an idea and the original context in which it was developed may be obscured over time, and then historical views of the idea can become distorted. I believe that the familiar square-root formula for the economic order quantity (EOQ) provides a remarkable example of this kind of historical distortion. Other reviews have discussed a number of the early EOQ papers (Raymond 1931, Whitin 1954, Mennell 1961), but much of the history of the development and dissemination of this model and formula has been left untouched. As we explore this history further, we shall see that the opening quote, which is taken from the preface to the biography of the eminent management engineer, Leon Pratt Alford, provides an unintended irony, for Alford himself played a prominent role in obscuring the origin of the EOQ formula.

Harris's 1913 EOQ Paper

The EOQ model and formula were presented originally by Ford Whitman Harris in a paper published in 1913 in *Factory, The Magazine of Management.* This paper (Harris 1913a) was disseminated widely: *Factory* had a readership of 10,000 at that time, with a target audience of manufacturing managers. The publisher of *Factory*, A. W. Shaw, was closely associated with the Harvard Business School during its early years, and was the first there to use actual business "cases" in teaching (Copeland 1958a, b, Ingham 1983, Cruikshank 1987). In 1911, a special gift from Shaw financed the establishment of the school's Bureau of Business Research. The A. W. Shaw Company was the first publisher of the *Harvard Business Review*, under an agreement by which all profits were returned to the school to support research activities. Shaw's company also published business books and other magazines, including *System, The Magazine of Business*, which became *Business Week* after McGraw-Hill acquired the Shaw publishing interests. Even with this seemingly auspicious origin, Harris's original

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EOQ paper was lost from sight for many years until its rediscovery in 1988 (Erlenkotter 1989).

Today the EOQ model is so well known that we accept its basic structure as obvious. In 1913, however, it was a modeling achievement of classical elegance. The simple square-root formula for the optimal order quantity followed directly from Harris's assumption of a continuous constant rate for demand and his recognition of the need to balance intangible inventory costs against the tangible costs for ordering. Versions of his depiction of cost tradeoffs in the "manufacturing quantities curves" have appeared in all standard works on the subject. Even his original presentation of the model, which defines costs on a per item basis, is easier to interpret than the standard textbook development, which expresses costs as an average per unit of time. Harris's basic EOQ model became the dominant paradigm for order-quantity analysis for at least the next 40 years.

In his paper, Harris emphasized that the EOQ formula was intended as a practical tool to be used intelligently, and not as a panacea to be applied indiscriminately. His second paper on inventories (Harris 1913b), which displays a broad view of the functions of inventory systems, shows that the calculation of EOQs was just one aspect of the overall management of the systems with which he was concerned.

A revision of Harris's original EOQ paper became a chapter in *The Library of Factory Management*, published by the A. W. Shaw Company in 1915 (Harris 1915). This six-volume work provides an extraordinary view of the field of factory management at the time of the First World War. It also was distributed widely, and is listed either as a set or by individual volume in several key, early bibliographies of management literature (Cannons 1920, Atkins 1923, Berg 1931). Sources for the chapters in these volumes were not cited, and the existence of the earlier paper (Harris 1913a) is not readily apparent from Harris's EOQ chapter. But, in the first volume, it is mentioned that much of the material was drawn from *Factory* and *System*.

Early Development of the EOQ Literature

Given the widespread circulation of Harris's EOQ formula, in both article and chapter versions, the degree of confusion about its origin is surprising. Although the original article may have been unknown for many years, the chapter version has been cited, albeit erroneously, since 1931 (Raymond 1931, Erlenkotter 1989). But some still date the origin of this formula to the mid-1920s (Baumol and Tobin 1989). Others call it the "Wilson lot size formula" (Morse 1958, Wagner 1980, p. 450), while to many Europeans it is known as "Camp's formula" (Eilon 1962). I shall trace the history behind this confusion.

Analysis of economic lot sizes was a common topic in factory management courses at the Harvard Business School in the early 1920s, and readings from *The Library of Factory Management* were used in these courses. However, Harris's chapter is not listed among the assignments. Harvard students undoubtedly learned a version of the EOQ formula from a paper by Green (1915), which was reprinted by Copeland (1917, pp. 427–439). Since Green provided no derivation for his formula, it seems likely that he followed Harris's earlier work even though no reference is given. As reported by Best (1930), an EOQ formula similar to Green's was used at Eli Lilly and Company from 1917 on.

The second major EOQ paper was by Taft (1918b), who developed the production lot size model. This model extends the simple EOQ model by incorporating a finite production rate. Although Taft did not reference any prior work, the degree of complexity in this paper is in such contrast to the descriptive nature of an earlier paper (Taft 1918a) that one suspects he must have been familiar with the simpler model.

During the 1920s there was a proliferation of EOQ papers. They appeared in magazines addressed to practitioners, and little attention was paid to previous work. For example, one author in a related area complained that a formula from one of his publications had been copied incorrectly and without acknowledgment by another author (Franklin 1928). By the late 1920s, the situation had become so confusing that the American Society of Mechanical Engineers (ASME) requested Fairfield E. Raymond of MIT to survey this literature with the goal of comparing and combining the previous studies. Raymond (1928, p. 80) noted 15 EOQ expressions derived by 12 writers; subsequently, he catalogued some 38 derivations of various formulas up through 1929 (Raymond 1931). When Raymond presented his *simplified* EOQ formula, one discussant commented about "Professor Raymond's radical embracing most of the letters of two alphabets" (Raymond 1930, p. 22). The simpler formula suggested by several other discussants was the same as the one given by Harris (1913a). From that time, this formula became standard. When Raymond (1931) gave Harris (1915) as the source for the EOQ formula, one might have thought that the originator's identity was resolved and discovery of Harris's earlier paper was imminent. Instead, the paper remained unknown, and confusion about the formula's origin persisted.

The Role of L. P. Alford

To gain more insight into the causes of this confusion, I turn to the intriguing relationship between L. P. Alford and the EOQ model. Perhaps best known today for his biography of Henry Laurence Gantt, Alford has been called the "pioneer of management handbooks" (Urwick 1956, p. 192) and "ASME's great recorder and interpreter of management history" (Gilbreth and Jaffe 1960, p. 5). He held key positions in ASME's influential Management Division from its inception until his death in 1942, and was the author of ASME's reports on the state of management in 1912, 1922 and 1932. His editorial roles were equally important: after serving as editor-in-chief of *The American Machinist* from 1911–1917 and *Industrial Management* from 1917–1920, he became associated with Ronald Press, where he held important editorial and executive positions for many years. At Ronald Press, he was editor successively of *Management Engineering, Management and Administration* and *Manufacturing Industries.*

One finds it hard to believe that Alford in his role as an editor was unaware of the contents of the magazines and other publications of a competing business publisher, such as A. W. Shaw Company. It seems quite revealing that by 1927 Ronald Press was advertising its own *Manufacturing Industries Library.* Harris certainly had some contact with Alford, who published four of Harris's pieces in *The American Machinist* in 1913. Alford and two of the editors of *The Library of Factory Management* were alumni of Worcester Polytechnic Institute. One of them, F. M. Feiker, chaired a committee in 1921 that investigated the opportunity for business courses at the Institute; Alford was a member of this committee. The other, Leon I. Thomas, was a contributing editor for *Manufacturing Industries* in 1928 under Alford's editorship; Thomas and Alford both resided in Montclair, New Jersey in the early 1930s. We also know that Alford had contact with A. W. Shaw. Alford prepared an analysis for the Committee on Recent Economic Changes of the President's Conference on Unemployment, originally chaired by Herbert Hoover. Shaw became acting chairman of this committee after Hoover's election to the presidency (Jaffe 1957, pp. 212–213). There is some evidence of friction between Alford and those at the Harvard Business School: C. Bertrand Thompson, a colleague of Shaw and contributor to *Factory* and *The Library of Factory Management*, had been critical of some of Alford's work in the 1912–1917 period (Jaffe, pp. 68–69).

Alford's active involvement with EOQ models began in 1924 with the publication of his *Management's Handbook.* The section on production control in this handbook, written by George De Albert Babcock, has the following to say about the determination of lot sizes (Alford 1924, p. 637):

> Accurate formulas, taking all these factors into consideration, lead to cubic equations which are difficult of solution.

Evidently Harris's EOQ model was less than obvious at least to this writer!

In 1927, Alford's paper on "Laws of Manufacturing Management" was published, for which he was awarded ASME's first Melville medal. One of his 43 *laws* was the "law of economic lot size" (Alford 1927, p. 416), which states:

> The quantity of product that can be manufactured at the lowest unit cost varies directly as the square-root of the preparation costs and inversely as the square-root of the interest charge, and storage charge.

Alford referenced Davis (1925, 1926) as the source for this *law.* The "laws of economic manufacturing lot sizes and economic purchase quantities" appear in more detail in Alford (1928), where works by Davis (1927), Pennington (1927), Lehoczky (1928) and Raymond (1928) also are mentioned.

The year 1933 was marked by the publication of the second of Alford's *Ten Years' Progress in Management* reports to ASME. In this report, Alford (1933, p. 8) referred to the ASME bibliography by Berg (1931), which includes the volume containing Harris's 1915 EOQ chapter. Alford (1933, p. 10) noted work on economic manufacturing lot sizes and economic purchase quantities, and mentioned Davis, Lehoczky, Pennington and Raymond as contributors in this area. He stated further that "Generous appreciation is due to those who have pioneered in this field, and who are thereby assisting in laying the foundation for a new economics." None of the men named had published work in this area before 1925.

Alford's *Cost and Production Handbook* appeared in 1934, three years after Raymond's identification of Harris as the originator of the EOQ model. This popular handbook, which had reached its tenth printing by 1940, declared that:

> William E. Camp was the first to present (1922) a general formula to determine the production order quantity, such that the total cost per unit for setting up plus interest on stores investment would be a minimum.

Here Alford (1934, p. 238) referenced Camp (1922). Camp, formerly an employee of Gantt, had published his paper in *Management Engineering* under Alford's editorship. This statement was repeated ten years later

by Alford and Bangs (1944, p. 101) in the *Production Handbook*, published two years after Alford's death.

It is difficult to believe that Alford, that diligent collector and interpreter of managerial knowledge, did not know of earlier EOQ work even before the appearance of Raymond's 1931 study. After 1931, it is inconceivable that he was unaware of Raymond's compilation of this early work. The pattern that emerges here is that Alford only cited work that appeared in journals he edited or in ASME Management Division publications. Even work that appeared in journals he had edited previously, such as Holden (1921), were ignored. This was not a new pattern: Alford's 1912 ASME report on *The Present State of the Art of Industrial Management* had been criticized by Gantt and Gillette for excluding non-ASME works (Jaffe, p. 69).

Some Post-Alford EOQ Attributions

In 1960, the American Society of Mechanical Engineers published a volume that commemorated the *Golden Jubilee of Progress in Scientific Management*. This volume is a compendium of ASME's *Ten Years' Progress in Management* and related reports, of which four had been written by Alford. A section of the 1960 report (Gilbreth and Jaffe, p. 5) opens with this statement:

> History is more than an integral part of the educated person's background; it is the *sine qua non* of mature thinking. It is only by a study of history that the work of those who came before us—and, eventually, the work that we ourselves do—can be examined objectively. Under history's microscope, . . . the 'captain of industry' may very well be shown as a figment of the imagination of a successful publicity campaign. History does more than record and evaluate what our predecessors did and thought. It makes us know the complexities of the accomplishments we so often take for granted.

Gilbreth and Jaffe (p. 12) then mention the EOQ and economic lot size formulas, comparing them to Lord Kelvin's law for the economical size of an electrical conductor, and state "These were all developed under ASME auspices." The reader is referred to Alford (1928) for details. I believe that the authors' opening statement provides an appropriate commentary on this claim. Although unrelated to his EOQ contribution, it should be noted that Harris was a member of ASME for 50 years, joining in 1913 and serving as founding secretary of ASME's Los Angeles section from 1915–1917.

The award for historical inconsistency in this area belongs to Maynard's well known *Industrial Engineering Handbook*, published by McGraw-Hill. In the first edition (Maynard 1956, pp. 8–182, 184), W. W. Hannon correctly identified the Harris and Taft formulas. But in the second edition (Maynard 1963, pp. 7–93), L. F. Sargent attributed the EOQ formula to Camp (1922) and stated that it was reprinted by special permission of *Management Engineering*! McGraw-Hill had acquired *Factory* in 1928 from A. W. Shaw, and so if anyone had a right to this formula at the time, it would seem to have been McGraw-Hill.

A final question to be considered is how the EOQ formula became identified with Wilson. A version of the formula appeared in the *Harvard Business Review* in a paper by Wilson (1934). Wilson followed the tradition of not citing earlier work, and no one seemed to notice that this type of formula had been used in student projects at the Harvard Business School for more than ten years. In a paper published earlier in the same journal (Wilson and Mueller 1927), Wilson seemed to have been unaware of the EOQ formula. Ironically, A. W. Shaw Company was the publisher for Wilson's first paper and McGraw-Hill was the publisher for the second.

Conclusion

From all this, what can we conclude about the obscuring of Ford Whitman Harris's EOQ paper of 1913 for so many years? Certainly a major cause was the lack of a scholarly tradition in this practical literature: beginning with Green (1915) and the 1915 *Library of Factory Management*, earlier work rarely was cited. Raymond (1931) saved Harris from total obscurity, but his erroneous citation of Harris (1915) seems to have been an effective roadblock to further search. The failure of Alford and his associates to recognize Harris's work, even after it was identified, is quite strange. Could the rivalry of competing groups provide an explanation? Harris's EOQ contribution was linked to A. W. Shaw's Chicago-based publishing activities, and Shaw was affiliated with the Harvard Business School. Alford was associated with rival New York City publishing interests and the ASME Management Division. The orientation of Alford's group was to attempt to codify managerial knowledge, and the EOQ formula fit naturally into their codification. But Alford showed no inclination toward publicizing the accomplishments of a rival group. Shaw, on the other hand, was influential in establishing the *case method* at the Harvard Business School, which then followed a path away from rigidly codified knowledge. For both groups, obscurity for Harris's EOQ contribution may have been a comfortable outcome.

PART II. FORD WHITMAN HARRIS: ENGINEER, MANAGEMENT SCIENTIST, PATENT ATTORNEY

While it is said that a man's life is reflected in his work, it is true that the history of a career may unveil a struggle with destiny and the upward way, step by step, by means of which he approached the ideals he sought . . . the adventures of his . . . life serve to enrich the fabric of his achievement.

Lena McCauley (1923)

Ford Whitman Harris, who is known to us primarily as the originator of the economic order quantity (EOQ) model, had a long and distinguished career as an engineer and a patent attorney. His career is the more remarkable in that he received no formal education after the age of 17: he was self-educated in the broadest sense of the term; he received more than 100 patents for inventions; he was admitted to practice before the U.S. Supreme Court; and, according to his daughter, he knew French and could recite from memory passages from Milton.

Harris's Life and Career

Ford Whitman Harris was born in Deering, Maine on August 8, 1877, the son of Fred Ford and Harriet Whitney (Fox) Harris. His father was an accountant. Through his great-grandfather, Ford Whitman, he was a descendant of two of the Mayflower Pilgrims, John and Priscilla (Mullins) Alden. He had three younger brothers and a younger sister; an elder sister died before reaching maturity. His early years were spent in the Portland area, in Deering and South Portland.

In 1896, Harris was employed by the Belknap Motor Company in Portland as an engineering apprentice, and three years later he became a draftsman for the Maine Electric Company in that city. In 1900 he took a position as a draftsman and engineer for Heyl and Patterson in Pittsburgh, Pennsylvania. From 1904–1912 Harris was employed by the Westinghouse Electric and Manufacturing Company in East Pittsburgh as a draftsman and engineer. In 1912 he became a consulting engineer in Los Angeles, and there he entered the field of patent law. He was admitted to practice before the U.S. Patent Office in 1914 and became a member of the California Bar in 1916. His admission to practice before the U.S. Supreme Court was in 1922.

In Los Angeles, Harris was initially associated with the firm of Townsend, Graham and Harris and later with the firm of Graham and Harris before opening his own office in 1923. In addition to his legal practice, he had various business interests, including positions as President of Big Rock Ranch Co. and Vice President of Wulff Process Co. and Patco, Inc. He died in Los Angeles on October 27, 1962 at the age of 85. The law firm that Harris founded still continues, and is now under the name of Harris, Kern, Wallen and Tinsley.

Ford W. Harris was a fellow and life member of the American Institute of Electrical Engineers, and a member of the American Society of Mechanical Engineers and the American Chemical Society. He was one of the founders and, in 1934, the first president of the Los Angeles Patent Law Association. Up to the time of his death he was a member of the American Bar Association and the American Patent Law Association. Harris also was a member of the California Club and, for many years, of the Wilshire Country Club.

Harris as an Engineer and Inventor

Harris's activities as an inventor spanned more than 50 years. His first (joint) patent, issued in 1904 and assigned to Heyl and Patterson, was for a speed controller. His last, issued in 1958 when he was 80 years old, was for components of a regenerative heat exchanger. Most of his early patents, up through 1916, were for electrical devices—circuit breakers and switches, fuses, and controllers for electric motors—and were assigned to Westinghouse. Many of the later ones were associated with petroleum extraction—devices for pumping oil, dehydrators and separators for oil emulsions, and apparatus for reaming wells. But scattered among these were other items such as a disc harrow, two automatic water heaters, and a "side-loading hearse with a fixed turntable."

As an electrical engineer, Harris contributed frequently to the discussions of technical papers in the *Transactions* of AIEE during the period 1910–1915. He also served on AIEE's Protective Apparatus Committee in 1915 and 1916. Although we have little direct knowledge about his decision to switch from a career in engineering to patent law, he left several clues in his published writings. In September 1914 he wrote of making patent office drawings for a local attorney "during a stringency in [his] personal finances," and he also commented:

A patent lawyer should be about eight-tenths engineer or inventor and two-tenths lawyer. If he has the mechanical gifts he can pick up the law, but unless he has a constructive imagination and the mechanical sense he will never get it by studying law books.

In another piece, published in April 1943, Harris adds some further information:

> . . . I made a precarious living as an engineer for a considerable period before I broke down the fence into what I thought was a greener pasture.

Given his skills and experiences as an inventor, the exposure to the world of patent law evidently suggested an attractive opportunity.

Harris's Contributions on Management

Ford Harris's writings on management topics must have begun soon after he left Westinghouse, for they were published in rapid succession beginning in 1913. His first full paper, "How Many Parts to Make at Once," in which he develops the EOQ model, appeared in *Factory, The Magazine of Management* in February 1913 and undoubtedly was written in 1912. Another paper, "How Much Stock to Keep on Hand," published in the following month, takes more of a *systems* view of the inventory function, and shows considerable understanding of the need for coordination between marketing, engineering, and production. In addition to systems topics, Harris wrote quite broadly about problems of organization and personnel in a style that is engagingly anecdotal. Many of these papers also appeared in *Factory*, an A. W. Shaw Company publication with an intended audience of "the manager in manufacturing" and 10,000 readers in 1913. One of Harris's papers, a noteworthy early contribution on the familiar *make or buy* problem, appeared in 1914 in *System, The Magazine of Business*, another A. W. Shaw Company publication, which was renamed *Business Week* after it was acquired by McGraw-Hill.

In 1915, the A. W. Shaw Company published *The Library of Factory Management*, a set of six volumes. An edited version of Harris's EOQ paper was included as a chapter under the title "What Quantity to Make at Once." For many years this chapter was believed to have been the original presentation of the EOQ model. Two of Harris's other papers, the second one on inventory systems and the one on the make or buy problem, also became coauthored chapters in these volumes. In addition, he is listed as a contributor of material to two other chapters: "Keeping Quality Up to Standard," and "Emergencies—The Crucial Test."

Although distributed widely, Ford Harris's original 1913 paper on the EOQ model was forgotten until its rediscovery in 1988. His chapter on the EOQ model in *The Library of Factory Management* was erroneously cited and apparently unread for many years. At various times, others have been credited with the development of the EOQ formula. It does not appear that Harris sought, received, or expected any recognition for this contribution during his lifetime. Even his own family was unaware that he had made such a contribution. Perhaps Harris's views toward such an intellectual discovery are captured in the following quotation, which appears in a review that he wrote in 1932 of a book that proposed a sweeping revision of the patent law system to grant patent rights to scientists for their scientific discoveries:

> Considered practically, [the book] deals with an abstraction not likely to become of practical importance for many years. The world is struggling with too many more pressing problems to worry about rewarding scientists for making discoveries for, after all, that is what scientists live for, and whether you reward them [or] not, they will go on making discoveries and, having made them, they will tell everyone about them.
>
> In this connection, it seems to the reviewer that if we reward a scientist for making an abstract discovery, we should also reward the business man who invests his time and money in making it productive, for after all, although Faraday discovered the laws of electromagnetic induction, it took vast sums of money and years of effort to put these laws to work for the benefit of mankind.

It is not surprising that Harris, an inventor himself, placed high value on the practical realization of abstract ideas.

Harris's Contributions to Patent Law

In the field of patent law, Ford Harris authored or coauthored two books and more than a score of articles, comments, and reviews. His writings in this area began in 1914 with a series on practical patent issues that was published in *Machinery*, and continued through 1954, when he was 76 years old. An early piece, published in 1921, is perhaps the most interesting to management scientists, because it is an elementary operations research analysis of the U.S. Patent Office. In it, he identified the Patent Office as a degenerate queue, with an arrival rate of 90,000 and a processing rate of 71,000 applications per year. After discussing the near-term consequences of this for the average waiting time per application, Harris made the following comment:

> This is enough to make a person turn Bolshevik when we consider that the inventors are paying all the Office expenses and that they are entitled to prompt action.

We do not know how much impact his analysis had, but the Patent Office Relief Bill, which had died in Congress early in 1921, was revived, passed and signed into law early in 1922. Since the relief provided was

inadequate, Harris addressed this problem again in an article published in 1929.

Another of Harris's publications, which appeared in 1951, deals with the subject of "Impositive Elements." Such a topic might be suspected to have some relation to operations research, but this piece does not have such pretensions:

> As to impositive elements, about twenty years ago I had an application for a gas furnace which had a partition with a 'hole' through which the gas passed. At least, I thought it was a hole and the claims specified 'a partition having a hole therein.'
>
> However, I was soon put straight on this. In paper No. 7 the Examiner said, 'There is no hole in the partition 13.' I referred to Fig. 3 of the drawing, pointing out the hole 14 in the partition 13. In paper No. 9 the Examiner stated, '13 is not a hole, it is a space forming an opening,' and upon our amending the claims to correctly describe the hole, excuse me, the space forming the opening, the patent issued.

One does not expect to encounter humor in legal journals!

Harris's Family

On November 4, 1905, at Baden, Pennsylvania, Ford Harris was married to Eugenia Mellon, who was born in Pennsylvania on November 17, 1881, the daughter of Edward Dominic and Henrietta Woodbridge (Cumming) Mellon. Eugenia (Mellon) Harris was the eldest of five children; her father was an oil dealer in Freedom, Pennsylvania, who moved with his family to Los Angeles by 1912. She died in Los Angeles on April 30, 1979 at the age of 97. The Harrises had two children: Ford Whitman, Jr., born in Wilkinsburg, Pennsylvania on December 9, 1907; and Jean Knox, born in Los Angeles on September 10, 1916. Both children graduated from Stanford University, and Ford, Jr. was a member of the law firm founded by his father until his death in 1977. Jean Knox Harris married Byron Owen Smith in 1938.

Harris's daughter, Jean Harris Smith, comments that her father was an enthusiastic golfer and trout fisherman who enjoyed exploring the entire Pacific coast up into British Columbia. He also was a photography "nut" who developed his own pictures. She adds:

> Purely social activities bored him, and my gregarious mother went out and about in the daytime and they stayed home nights. This was lovely for us, his children. . . . He was also one of the funniest men alive. I always thought he could have been another Mark Twain if he had chosen to go that route. His letters to me at Stanford kept all my friends endlessly amused. That light touch and wit probably explains why anyone so basically unsocial was so universally loved and admired.

As we have seen, Harris's humor was quite evident in his professional writings as well.

Conclusion

One of the memorials to Harris written after his death concluded with these words:

> Many local patent lawyers obtained their start under his kindly advice and training. His kindness and adherence to principles will long remain an inspiration to all who knew him.

Although we may remember Ford Whitman Harris primarily for his contribution of the EOQ model, his life has a significance and meaning for us that extends far beyond this single accomplishment.

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