

# The History and Evolution of Hitting Distances and Golf Course Lengths Before 1980

## Executive Summary

An extensive literature review was completed to examine the evolution and influencers of hitting distances and course lengths throughout the history of the game. An analysis of contemporary sources indicates that hitting distances and course lengths have been increasing since the 1890s. The causes of this increase in hitting distances and course lengths have varied through time and it is not possible to assign discrete increases to any single factor or factors. Rather, what emerges is an understanding that a combination of factors has resulted in increases in hitting distances through time; and that increases in hitting distances have been the primary driver of course lengthening since about 1900. The concurrence of these increases suggests a cyclical relationship – increases in hitting distances lead to increases in course lengths; further, rates of course lengthening have been higher immediately following those times when increases in hitting distances have been high, and rates of course lengthening have been slower following those times when increases in hitting distances have been slower.

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# Methodology

## Hitting Distance Data Collection

Many sources of information allow for an historical assessment of hitting distances in golf in the decades prior to 1980.<sup>1</sup> These sources include:

- Media coverage of golf competitions published in contemporary golf periodicals and newspapers that report single or average hitting distances by a player or players
- Biographical profiles of elite players published in contemporary golf periodicals and books that report the subject's typical hitting distances
- Instructional articles and books written by elite players that report the author's typical hitting distances
- Instructional articles and books that report typical hitting distances of contemporary elite and recreational players
- Descriptions of the game published in non-golf books and periodicals that report typical hitting distances of elite and recreational players

To complete this study, more than 2000 individual reports of hitting distances were collected from more than 500 different sources published between 1790 and 1980. To support the subsequent analysis of this information, metadata were appended noting the gender of the player, level of play (elite or recreational; elite players were further subdivided into professionals and amateurs, to see if there are any meaningful differences between these groups), and club used. Research focused on source materials in English to facilitate the collection of reports; as such, the information represents primarily golf in the British Isles, Canada and the United States. However, a limited number of sources from other countries were consulted to confirm general consistency in other regions of the world; these sources have not been included within this report.

Naturally, reports of driving distance include atypical shots, being either shots hit unusually long distances or mis-hits that travel unusually short distances. In every decade, reports of drives approaching and even exceeding 400 yards were found; these have been excluded as they were clearly assisted by unusual conditions (e.g., strong tailwinds, extreme elevation changes, unusually hard and dry conditions, etc.). When it is clear from the context that a shot was mis-hit (e.g., "topped," "skied," "smothered," "foozled"), the data have also been excluded. Tee shots using irons on a par-3 hole also

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<sup>1</sup> Systematic measurement of hitting distances is a relatively recent development. It was not until 1980 that the PGA TOUR began to collect and report driving distance on an annual basis (noting that the first season-long measurements of driving distance were collected in 1968 and 1969, just not continuously thereafter). It is for this reason that 1980 was selected as the end date for this project. Presentation and analysis of post-1980 data appears in other reports that are part of the Distance Insights report library.

have been excluded from the analysis of driving distance. These exclusions help focus the analysis on typical driving distances, which are the focus of this report.

Further, the data have been segmented by decade (e.g., 1900-1909); and within each decade, the primary conclusions on typical driving distances were developed based on a trimmed mean of the reported distances, and further expressed as a range that represents generally from 25% below to 25% above the mean.

In addition to identifying the range of typical driving distances for each cohort of golfers, further research and analysis was completed to identify an upper range of hitting distances for both male and female elite players, as longer drives are more likely to create pressure on the length of a golf hole and thus drive lengthening over time. In general, these ranges of longer drives are constructed around the 90th percentile of the reported hitting distances. In the tables of hitting distances that appear in each section of the document, these longer ranges are identified under the column header “Long Drives.”

Because reports about recreational golf are extremely limited, typical driving distances of recreational golfers for each era are based on the indications of expected or suggested driving distance from instructional books and articles. These sources are limited in number, particularly when considering a single decade, making it difficult or impossible to apply typical statistical tools and methods. Conclusions reflect approximate averages or typical ranges of yardages that are referenced.

### Limitations of Historical Sources

The methods and tools used to measure driving distance before 1980 typically were not reported and so the reliability of individual reports can be difficult to assess. The language used in most sources to describe a shot (for purposes of illustration, a description such as “he drove the ball 207 yards from the 6<sup>th</sup> tee”) indicates that some methodology was being employed to ensure accuracy rather than generality (e.g., “he drove the ball about 200 yards”). Obviously, authors cannot be queried about their sources or the precision of their language (e.g., the difference between “average” vs. “median”; or the intent of qualifying words such as “typically,” “generally,” “often” and “sometimes”), and therefore interpretation is necessarily required based on the context. Naturally, in collecting and assessing historical data, there will also be individual data points that appear to be anomalies or outliers (just as there are in modern data sets, when, for example, a player tops a drive or hits an unusually long drive assisted by wind, dry turf or elevation changes). These exceptional data points notwithstanding, it is evident that there are trends over both long and short periods of time that can be identified when considering large collections of historical quantitative information. Consistent with the methodology described above, it is these trends and the overall orders of magnitude indicated, and not individual data points, that are the focus of this report.

### Notes on Contributors to Distance

An extensive literature review was completed to identify the potential contributors to hitting distances before 1980. Wherever possible, priority was placed on contemporary source materials, noting that retrospective histories sometimes contain misinterpretations of earlier source materials, mistakes introduced inadvertently through errors in transcription, and other similar inaccuracies. This report

reflects the usual approach of historians to apply best judgment in assessing the quality and reliability of various source materials and to make choices to avoid introducing bias into the results.

In assessing the potential contributors to hitting distances, this study used the general framework developed in the Distance Insights project that key contributors to distance include: 1) the golfer (including methods and techniques for playing the game; and noting the variations by age, gender, athleticism, skill and level of experience); 2) the equipment used to play the game; and 3) the nature, design and conditions of the golf course.<sup>2</sup>

Given the nature of the information available, this study did not seek to identify or assign discrete incremental changes in hitting distances with any contributing factor. Rather, the purpose is to identify those developments within each era that may have affected hitting distances.

### Notes on the Evolution of Golf Course Lengths

This report contains multiple references to golf course lengths from the late 19th century to 1980. The source for this information is H09 – Analysis of the Evolution of Course Length. The information contained on golf course lengths before 1850 was collected from other source materials, as cited in the relevant footnotes.

Information on the contributors to golf course lengths worldwide before 1980 was collected through an extensive literature review, with priority placed on contemporary source materials. Important sources consulted for this project included: 1) commentary on individual golf courses and golf course design in contemporary golf periodicals; 2) similar content in contemporary newspapers and non-endemic magazines; 3) monographs focused on golf course architecture and golf course architects; and 4) histories of individual golf clubs and courses.

As above, given the nature of the information available, this study did not seek to identify or associate discrete incremental changes in course lengths with any contributing factor.

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<sup>2</sup> There is considerable literature on the physics of golf that explains what happens when a ball is struck; important sources that informed this study include Alastair Cochran and John Stobbs, *The Search for the Perfect Swing*, Philadelphia and New York, J.B. Lippincott and Company, 1968, esp. pp. 143-178; various papers in Alastair Cochran (editor), *Golf: The Scientific Way*, Hemel Hempstead, England, Aston Publishing Group, 1995; and the five volumes of proceedings published by the World Scientific Congress of Golf: Alastair Cochran, M.R. Farrally, Eric Thain, Debbie Crews and Rafter Lutz, editors, *Science and Golf: Proceedings of the World Scientific Congress of Golf*, various locations, various publishers, 1990, 1994, 1999, 2002, and 2008. A good summary of the topic written in non-technical language is provided by Frank Thomas and Jeff Neuman, *Just Hit It: Our Equipment and Our Game*, Champions Gate, Fla., Frankly Publications, 2008, pp. 71-90. One factor that contributes to distance that has not been analyzed in this project is weather and its impact on course conditions; variation due to weather is seasonal, and at times even daily, greatly limiting the ability to assess weather as a long-term contributor to hitting distances or course lengths. That said, golf architects have certainly recognized the impact of weather on hitting distances and have responded to potential weather variability when designing courses; an early and important discussion of this issue was provided by William Langford, *Golf Course Architecture in the Chicago District*, Chicago, 1915, pp. 1, 3 and especially pp. 10-11 where the author demonstrated calculations of hole lengths based on weather conditions.

# Historical Evolution of Hitting Distances and Golf Course Lengths

## Before 1850

### Hitting Distances Before 1850

The few contemporary documents that inform an understanding of hitting distances in golf prior to the middle of the 19th century suggest a general range of driving distances between 150-200 yards for a typical player and up to 220 yards for the longest hitters. (There was one report of a drive in excess of 360 yards in 1836 which is considered an anomaly assisted by strong wind and unusual ground conditions.) Additional sources from the second half of the 19th century looking retrospectively at this era report similar distances and golf historians largely have accepted a range of 150-200 yards as a typical driving distance in the pre-1850 era. It should be noted, however, that the feather ball used in this era performed poorly in wet conditions when it became heavy and soggy; one player of this era, writing 50 years after the fact, recalled that it could be difficult to drive a saturated feather ball 100 yards.<sup>3</sup>

None of the available sources differentiate between male and female hitting distances, although it is believed that very few women played golf in this era, leading to a logical conclusion that the driving distance references located for this study refer exclusively to men; likewise, the concept of “professional golf” did not exist and contemporary sources do not distinguish between elite golfers and typical golfers, so there are no meaningful distinctions between segments of golfers that can be formulated for this time period.

### Contributors to Hitting Distances Before 1850

Based on the nature of the historical sources, and the lack of methodical measurement of distance during this time period, it is not possible to determine if hitting distances increased at any time during this era, nor is it possible to quantify the individual contributions of various factors to overall hitting distances. Nonetheless, it is possible to identify the significant factors that could have influenced hitting distances before 1850:

- a) Feather ball – The feather ball that was used as far back as the 16th century (and possibly earlier<sup>4</sup>) until the middle of the 19th century comprised a hand-sewn leather sack stuffed with boiled feathers that was very firm and elastic when finished.<sup>5</sup> The surface of the ball was

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<sup>3</sup> A.H. Doleman, “The Rubber Ball Controversy,” *Golf Illustrated: The Weekly Organ of the Royal and Ancient Game*, London, January 30, 1903, p. 93

<sup>4</sup> While some historians have asserted that a wooden golf ball may have been used in the 15th and 16th centuries, there is no archaeological or contemporary literary evidence to confirm the use of a ball made of wood.

<sup>5</sup> For a discussion of the manufacture and properties of a feather ball, see Peter Lewis, “The History of the Golf Ball in Britain” in Alastair Cochran, editor, *Golf: The Scientific Way*, Hemel Hempstead, U.K., Aston Publishing Group, 1995, pp. 165-166.

smooth when completed, but with use the leather surface became scuffed, which improved the ball's flight.<sup>6</sup>

- b) Long-nose woods – Early wood clubs featured narrow, long (up to 6" from heel to toe) and shallow clubheads with comparatively flat lies (typically around 55 degrees, but examples exist as shallow as 40 degrees) and thin and long shafts (typically 46"-47", but there are examples that are 48" or longer).<sup>7</sup> Lead was commonly added to the back of the clubhead, and occasionally to the sole, to add weight and increase striking power. A player would have utilized a small number of wooden-headed clubs (5 or 6, typically) of graduated length and loft; the "play club" had the longest overall length and least loft and was used to drive from the tee. The earliest surviving examples (attributed to the early 1600s or perhaps late 1500s) were large, blocky and heavy with thick necks and deeper faces; by 1850s, clubheads had become more delicate, more graceful, and, importantly, lighter, so easier to swing.
- c) Irons –The earliest known irons from the 1600s and 1700s feature very large and heavy clubheads with long (5-6") and thick hosels that were useful for extracting a ball from deep rough, cart tracks, etc. The fragile nature of the feather ball limited the use of iron clubs. They were also costly and caused damage to the turf. Smaller and lighter clubheads became more common in the early decades of the 19th century, making the clubs easier to swing, but their use was still limited.
- d) Winter conditions – Golf was largely a winter activity through the early centuries of the game's history.<sup>8</sup> Prior to the Industrial Revolution, the populations of the agrarian communities in Scotland and England had little time for sports and other recreational activities from the time of spring planting through the early fall harvest. Moreover, the land on which the game was played in many towns was often planted with crops or used for grazing livestock during the summer months. Dormant turf, thin turf coverage and sometimes frozen ground contributed to firm and fast conditions through the green during the months when the game was most frequently played.
- e) Swing technique – The flat lie of long-nose woods promoted a swing plane that was much flatter than the modern golf swing. The flat, sweeping swing in combination with the feather ball that featured a comparatively smooth surface produced a low-trajectory ball flight capable of significant roll on the winter turf.<sup>9</sup>

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<sup>6</sup> Irregularities on the smooth surface would have served a similar purpose as dimples on a modern ball, reducing drag and creating lift to improve the ball's performance.

<sup>7</sup> These measurements were made of clubs from the collection of the USGA Golf Museum, as well as several private collections; the author expresses gratitude to Elmer Nahum for sharing his research (collected in preparation for his recently published book, *Practical Clubmaking: A Guide to Long Nose Era Golf Clubmaking*, Sewickley, Penn., Short Spoon Press, 2019). See also Robert G. Gowland, *The Oldest Clubs 1650-1850*, Robert Gowland & Associates, no place, 2011.

<sup>8</sup> See David Hamilton, *Golf – Scotland's Game*, Kilmacolm, Scotland, Partick Press, 1998, pp. 52-55, 64, 110. An important exception to this generality is St Andrews, where records of summer play exist starting in 1768 and continuing thereafter, these being reports of meetings of the Royal and Ancient Golf Club in June and July. Summer play became increasingly common in the early decades of the 19th century.

<sup>9</sup> The thin, whippy shaft of the long-nose era would have helped elevate the trajectory, but not enough (comparatively) to overcome the poor aerodynamic properties of the feather ball.

## The Evolution of Golf Course Lengths Before 1850

Given the scarcity of historical documentation, little is known about the character, evolution and dimensions of the few golf courses that existed prior to the mid-1700s. From the middle of the 18th century (during the feather ball era) until the latter half of the 19th century (during the gutta percha ball era; see below), variability in total course lengths was more dependent on the number of holes than it was on hitting distances. A survey of Scottish golf courses from the first half of the 19th century shows that the number of holes varied from four (Peterhead) to 18 (St Andrews), with more than 50% of courses having eight holes or less.<sup>10</sup> Contemporary texts indicate that individual holes ranged in length from 100 yards to 600 yards,<sup>11</sup> while overall course lengths ranged from less than 2000 yards (Fortrose) to nearly 6400 yards (St Andrews). The research did not identify any clear correlations between the number of holes or the course lengths and the founding date of the golf course.

## Circa 1850 to Circa 1900

### Hitting Distances Circa 1850 to Circa 1900

Analysis of the information collected from contemporary source materials indicates that typical driving distances for skilled male golfers initially dropped to about 160-180 yards circa 1850 following the introduction of the gutta percha ball. By the late 1890s, these players typically drove 160-200 yards off the tee, noting that reports of individual drives of up to 220 yards were not uncommon. While the distinction between amateur and professional matches and competitions emerged during this era, there are no discernable differences between the reported hitting distances of golf professionals and elite amateurs during this time period.<sup>12</sup>

Assessing hitting distances for the recreational game during this same time period is difficult, in that there are very few contemporary reports of recreational play. Instead, approximations of hitting distances for recreational golfers can be gleaned from contemporary instructional books and articles and general descriptions of the game that contain references to the typical hitting distances that might be expected for a recreational golfer of the time. By the late 1890s, according to such sources, driving distances that could be expected of a typical recreational male golfer were in the range of 100-150 yards.

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<sup>10</sup> Peter Lewis, *Why Are There Eighteen Holes?*, St Andrews, Scotland, The Royal and Ancient Golf Club of St Andrews, 2016, p. 35.

<sup>11</sup> For a review of the various 18th- and 19th-century sources that reference contemporary hole lengths, see Peter Lewis, *Why Are There Eighteen Holes?*, St Andrews, Scotland, The Royal and Ancient Golf Club of St Andrews, 2016, pp. 32- 35.

<sup>12</sup> Allan Robertson (1815-1859) of St Andrews is often recognized as the first golf professional, but in truth was among an early group of individuals who made a living from the game as a clubmaker, ballmaker, caddie and/or greenkeeper who also played in challenge matches for money. On the history and evolution of the golf professional, see Billy Detlaff, *Doctors of the Game: A History of the Golf Profession*, Ponte Vedra Beach, Fla., self-published, 2016.



While there are isolated historical references to women playing golf in the late 18th century and earlier, the women's game became more firmly established between the late 1860s and about 1890.<sup>13</sup>

Information about women's hitting distances is not available prior to the late 1890s. Reports from this era suggest that elite female players typically drove the ball between 120-140 yards and occasionally as long as 170 yards; and that recreational female golfers typically drove the ball between 75-100 yards.

The following table summarizes the ranges of reported hitting distances for these key cohorts of golfers circa 1900.

*Table 1 Ranges of reported hitting distances circa 1900.*

Date	Recreational Women	Recreational Men	Elite Women		Elite Men	
			Typical Drives	Long Drives	Typical Drives	Long Drives
<b>Circa 1900</b>	75-100 yards	100-150 yards	120-140 yards	150-170 yards	160-200 yards	200-220 yards

### Contributors to Hitting Distances Circa 1850 to Circa 1900

An extensive body of writing on golf emerged in the second half of the 19th century, fueled by the game's growth in the British Isles and beyond. Contemporary sources provide first-hand insights into significant developments that impacted hitting distances during this era:

- a) Gutta percha ball – Made from the hardened sap of a tree indigenous to southeast Asia, the gutta percha ball first gained popularity in the late 1840s and replaced the feather ball entirely by the early 1860s. The first gutta percha balls were hand-rolled and finished with smooth surfaces that produced poor flight characteristics. Within just a few years, ball makers started to experiment with creating surface patterns on the gutta percha ball using a hammer and chisel in order to improve its flight properties; by the 1870s/1880s, surface patterns with finer incised lines were incorporated into the brass molds that were introduced to expedite and expand ball production. The introduction of the bramble pattern in 1894 marked the final evolution in cover

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<sup>13</sup> Historical records indicate that there were competitions for women before 1860, but these were rare and unusual, the most notable being the "Fish Ladies of Musselburgh." The Ladies' Golf Club in St Andrews was formed in 1867, but their play was limited to a long putting course with holes that ranged from 20-40 yards. In 1868, in North Devon, a Ladies' Club was formed that played on a course with holes that ranged from 50-120 yards, but again using only a putter. At some time in the late 1880s to early 1890s, the women of these clubs started to play golf with a full swing and with clubs other than a putter. On the early history of women's golf, see Rhonda Glenn, *The Illustrated History of Women's Golf*, Dallas, Texas, 1991; Malcolm Crane, *The Story of Ladies' Golf*, London, Stanley Paul and Company, 1991; Lewine Mair, *One Hundred Years of Women's Golf*, Edinburgh and London, Mainstream Publishing, 1992; and David Stirk, *Golf – History & Tradition, 1500-1945*, Excellent Press, Ludlow, UK, 1998, pp. 273-281.

design for the gutta percha ball. In contrast to the feather ball, the gutta percha ball was durable, easy to make and inexpensive. However, the material was hard and less elastic and so produced less bounce and roll. Contemporary sources noted that first generation of smooth gutta percha balls could not be hit as far as a feather ball (it was only later, in 1880s or 1890s, that typical hitting distances with the gutta percha ball started to approximate hitting distances with a feather ball); it was instead the cost and durability of the new ball that drove its adoption.

- b) Long-nose woods – The latter half of the 19th century first saw the evolution from the delicate long-nose woods that were common in the feather ball era to far more durable, heavier club heads (i.e., greater mass) that were wider from front to back and featured deeper faces (as measured from sole to crown). By the 1880s, clubheads were also becoming shorter in length from heel to toe (now less than 5"). The change in clubhead shape was largely in response to the hard gutta percha ball, which initially caused the heads of long-nose woods to split. During this era, shafts became shorter and thicker.
- c) "Bulger" driver – A radical design for wooden clubs was introduced in the late 1880s – the so-called "bulger" driver that was considerably shorter (less than 4 ½") and broader (about 2 ½") than a traditional long-nose wood, with a face that was convex rather than concave and a shape that placed more mass directly behind the ball. The new design quickly replaced the long-nose form, which all but disappeared by the mid-1890s
- d) Irons – Iron clubs evolved significantly and became more popular between 1850 and 1880 in response to the durability of the gutta percha ball and evolution in swing techniques. No longer were irons used solely to extract the ball from a difficult lie, but now were used for approach shots to the green. As such, iron clubs continued to become smaller and lighter and lofts became variable. The cleek (used for long approaches) and loftie (used for short approaches) emerged by 1870 and quickly became standard equipment; likewise, the mashie was created in the early 1880s but did not become popular until about 1890. Soon thereafter followed greater experimentation, variation and ultimately adoption in iron lofts, lengths and clubhead shapes, such that irons outnumbered woods in a standard playing set by the 1890s.
- e) Club patents – A significant number of British and American patents for golf club innovations were filed and approved in the 1890s. These patents represented considerable experimentation in clubhead shape, design and material, most of which proved short-lived, notwithstanding a small number of innovations (e.g., metal woods, adjustability in irons and woods, composite materials) that advanced the playability and performance of clubs for players of varying abilities.<sup>14</sup>
- f) Clothing – Traditional golf attire before 1900 was often restrictive in nature – heavy wool jackets and ties were common for men; wool jackets, boned corsets, stiff collars, bustles, drawers, two petticoats, long skirts and large hats for women; which is to say that clothing was voluminous, heavy and restrictive for men and women alike.<sup>15</sup>

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<sup>14</sup> An extensive list and collection of American golf club patents can be found in Robert Smith, *Golf Club: U.S. Patent Index 1894-1940*, St. Louis, Missouri, self-published, 1992.

<sup>15</sup> See Rhonda Glenn, *The Illustrated History of Women's Golf*, Dallas, Texas, Taylor Publishing, 1991, p. 7, 1-12; and David Stirk, *Golf – History & Tradition, 1500-1945*, Excellent Press, Ludlow, UK, 1998, pp. 281-283.

- g) Swing technique – Thicker shafts, stouter club heads and the more durable gutta percha ball encouraged a more forceful swing, while the shorter overall length of transitional woods promoted a more upright swing. Golfers were able to swing harder at the ball to encourage longer carry (important, given that the gutta percha ball produced less roll).<sup>16</sup>
- h) Golf instruction – The earliest known book to contain instruction on how to play the game, and specifically how to swing for maximum distance, appeared in 1857 – H.B Farnie, *The Golfer's Manual*; at the time, Farnie was a young student at the University of St Andrews.<sup>17</sup> It would be nearly 40 years before the first book of instruction written by a recognized golf professional – two-time Open champion Willie Park, Jr.<sup>18</sup>
- i) Lawn mowers – The invention and adoption of lawn mowers improved the consistency and lowered the height of turf on golf courses. When first introduced on golf courses in the second half of the 19th century (the lawn mower was invented in England at the end of the 1820s and first manufactured in the early 1830s<sup>19</sup>), mowers were used only for putting greens and immediately surrounding areas; the concept of a mown fairway stretching from tee to green did not exist. As early as the 1880s and certainly by the 1890s, however, some courses were using horse-drawn mowers to create fairways<sup>20</sup>; the machines available at the time were capable of cut heights of 1" to 1.5"<sup>21</sup> Prior to the of lawn mowers, the height of the grass was typically maintained by grazing sheep and rabbits, else cut by hand using scythes.
- j) Course Conditions – Golf evolved from a winter activity to a summer activity following the Industrial Revolution. It is difficult to pinpoint a precise date for this change, but historians believe that the shift in seasonal play was complete by mid-century. While summer conditions were likely drier (), summer play featured living turf that would have been longer and thicker, diminishing roll. In the later decades of the 19th century, the game began to be played with increasing frequency on inland sites (i.e., not on linksland). Many inland sites featured heavy or clay-rich soils that became very soft and mushy in the winter, but were rock hard in the summer.<sup>22</sup> Given the variability of turf conditions, and the difference in turf conditions from the traditional linksland course, there were some instructors who advocated for different swing techniques, philosophies of play, and even equipment for use on an inland course, in part to maximize distance.<sup>23</sup>

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<sup>16</sup> See, for example, Douglas Rolland, "Long Driving and its Secret," *Golf Monthly*, April 1914, p. 117, who noted that "the old gutty had to be hit, and hit hard."

<sup>17</sup> "A Keen Hand" (pseudonym for H.B. Farnie), *The Golfer's Manual, being an historical and descriptive account of the national game of Scotland*, Cupar, Scotland, Whitehead and Orr, 1857

<sup>18</sup> William Park, Jr., *The Game of Golf*, London, Longmans, Green, 1896

<sup>19</sup> For the history of lawn mowers, see James B. Ricci, *Hand, Horse and Motor: The Development of the Lawn Mower Industry in the United States*, Haydenville, Mass., North Farms Press, 2016.

<sup>20</sup> Robert Price, *Scotland's Golf Courses*, Aberdeen, Scotland, Aberdeen University Press, 1989, pp. 27, 29

<sup>21</sup> SU02 – The Evolution of Fairway Agronomy, p. 1

<sup>22</sup> Geoffrey S. Cornish and Ronald E Whitten, *The Architects of Golf: A Survey of Golf Course Design from Its Beginnings to the Present, with an Encyclopedic Listing of Golf Course Architects and Their Courses*, New York, HarperCollins, 1992, pp. 18-19. The variable conditions of the turf presented challenges for architects with respect to distance, but many ultimately settled on shorter lengths given that dry and hard conditions often prevailed in the months when the game was played.

<sup>23</sup> See, for example and most notably, Edward (Ted) Ray, *Inland Golf*, London, T. Werner Laurie, 1915.

## The Evolution of Golf Course Lengths Circa 1850 to Circa 1900

Nascent growth in golf participation fueled new golf course construction in the United Kingdom, United States and elsewhere in the 1880s and 1890s. More than 75% of these new golf courses were 9-hole courses, but the percentage of 18-hole courses among new course openings increased closer to 1900.<sup>24</sup> By the late 1890s, the median yardage for a typical 18-hole golf course was around 5100 yards; the lengths of the longest (90th percentile) golf courses, as well as golf courses used for elite competitions, typically approached or exceeded 6100 yards (see H09 – Analysis of the Evolution of Golf Course Lengths).<sup>25</sup>

An analysis of historical source materials suggests that the following developments could have contributed to increases, and in a very small number of cases decreases, in golf course lengths over this time period:

- a) Standardization – The first appreciable increases in golf course lengths occurred toward the end of the 19th century, due almost singularly to the expansion of many golf courses to 9 or 18 holes. This move toward standardization of golf courses to 9 or 18 holes was precipitated by the emergence of the Royal and Ancient Golf Club of St Andrews as the rule-making authority for the game by the 1890s and reflected the simple fact that the St Andrews rules stipulated that a round of golf comprised 18 holes (the number that had existed on the Old Course since 1764).<sup>26</sup>

A second manifestation of the trend toward standardization was driven by the identification and imitation of exemplary golf courses. Efforts to identify and describe the best golf courses in the British Isles first appeared in magazines and books in the 1880s.<sup>27</sup> The number of articles written on this topic grew significantly in the 1890s and the content expanded beyond description of golf courses to include critique of the elements and characteristics of golf courses that provided

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<sup>24</sup> For data on the percentage of 9- and 18-hole golf courses by date, see Robert Price, *Scotland's Golf Courses*, Aberdeen, Scotland, Aberdeen University Press, 1989, pp. 31-32, 204-225; and Peter Lewis, *Why Are There Eighteen Holes?*, St Andrews, Scotland, The Royal and Ancient Golf Club of St Andrews, 2016, pp. 207-210, 227-229.

<sup>25</sup> The 1896 U.S. Amateur was held at Shinnecock Hills Golf Club in Southampton, N.Y., and the course measured 5369 yards, while the length of Chicago Golf Club in Wheaton, Ill., host of both the Amateur and Open in 1897, was 6020 yards. In 1900, the last year of the gutta percha era, the U.S. Amateur was played on the 6070-yard course at Garden City (N.Y.) Golf Club. At 6248 yards, Lytham and St. Annes was the longest golf course in the British Isles in 1899.

<sup>26</sup> Peter Lewis *Why Are There Eighteen Holes*, St Andrews, Scotland, The Royal and Ancient Golf Club of St Andrews, 2016, pp. 207-215. See also Robert Browning, *A History of Golf: The Royal and Ancient Game*, London, J.M. Dent and Sons, 1955, pp. 59-63.

<sup>27</sup> *The Golfing Annual*, published between 1888-1910, included descriptions and analysis of the most important golf courses in the British Isles (and, occasionally, beyond); the 1889 volume included a 12-page article by Horace Hutchinson titled "How to Layout Links and How To Preserve Them" that many historians consider to be the seminal writing on golf course architecture; see C.R. Bauchope and David Scott Duncan, editors, *The Golfing Annual*, London, Horace Cox Publishers, 1888-1910.

the best tests of the game; naturally, one of these characteristics was length.<sup>28</sup> Horace G. Hutchinson's *Famous Golf Links* and *British Golf Links*, published respectively in 1891 and 1897, were the first monographs on the topic and contained detailed descriptions of the "leading golf links" of the day.<sup>29</sup> Looking collectively at this growing body of literature, it is apparent that the courses held in highest esteem at the time were 18-hole courses that often approached and exceeded 6000 yards in length. Which is to say, from the time that golf course criticism emerged as a distinct literary form, clear connections were drawn between longer lengths, good tests of golf and great courses. With a limited number of exceptions, the course identified by most contemporary sources as the ideal links was the Old Course at St Andrews.<sup>30</sup> The influence of this thinking likely contributed to the lengthening of existing and new courses that occurred in the years leading up to and beyond 1900.<sup>31</sup>

b. Golf Course Architects – Concurrent with the trend toward standardization was the emergence of golf course architecture as a unique discipline. Golf professionals, including Allan Robertson and Tom Morris, Sr., were among the earliest practitioners of golf course layout and design as early as the 1840s.<sup>32</sup> Robertson and Morris, both being from St Andrews, were no doubt influenced by the test of golf provided by the Old Course, including the length of individual holes, the general number of types of holes (one-shot, two-shot and three-shot holes), and correspondingly the overall length of the golf course. In this way too, imitation drove

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<sup>28</sup> On the history of writing about golf course architecture, together with an extensive bibliography of important works, see Geoffrey Cornish and Michael J. Hurdzan, *Golf Course Design: An annotated bibliography with highlights of its history and resources*, Worcestershire, England, Grant Books, 2006; and especially pp. 26-29.

<sup>29</sup> Horace G. Hutchinson, *Famous Golf Links*, London, Longmans, Green and Co, 1891; and Horace Hutchinson, ed., *British Golf Links: A Short Account of the Leading Golf Links of the United Kingdom*, London, J.S. Virtue and Co., 1897. The first book to describe the leading golf courses in the United States was James P. Lee, *Golf In America, A Practical Manual*, New York, Dodd, Mead and Company, 1895; Lee highlighted Shinnecock Hills Golf Club on Long Island as the exemplary course in the United States.

<sup>30</sup> An attempt to list the many contemporary sources that identify the Old Course as the exemplary model of a golf course would run onto multiple pages; a quote from James Balfour, *Reminiscences of Golf on St. Andrews Links*, Edinburgh, Scotland, 1887, pp. 4-5, encapsulates the widespread sentiments of the time: "The Course is marvelously adapted to the game. It used to be flanked by whins for the greater part of its extent, and these formed an interesting hazard. The turf is smooth and fine; the subsoil is sandy; the surface sometimes is undulating and flat. There are beautiful level putting greens, while the Course is studded with sand-pits or bunkers as golfers call them. These, with the ever-recurring hazards of whin, heather and bent all combine to give endless variety, and to adapt the Links of St. Andrews to the game of golf in a way quite unsurpassed anywhere else... it may be truly said that probably no portion of ground of the same size on the whole surface of the globe has afforded so much innocent enjoyment to so many people of all ages from two to eighty-nine, and during so many generations." See also Garden Smith, editor, *The World of Golf*, London, A.D. Innes and Co., 1898, pp. 22-27, who included an assessment of the length of holes of the leading courses in Scotland and England to explain the superiority of the Old Course.

<sup>31</sup> On the important influence of St Andrews with respect to length of new courses, see H.J. Whigham, *How To Play Golf*, Chicago and New York, Herbert S. Stone and Company, 1897, p. 201: "The nearest approach to perfection in the matter of distances was made by the original founders of the St. Andrews links in Scotland." Further, Whigham (pp. 204-206) highlighted Prestwick and Sandwich as other courses that should be emulated with respect to length, concluding that "in laying out an eighteen-hole course you may imitate any of these three links with advantage."

<sup>32</sup> One of the first books to describe and discuss the earliest golf course architects and their work was John Kerr, *The Golf Book of East Lothian*, Edinburgh, Scotland, T. and A. Constable, 1896. Modern historians identify Allan Robertson's modifications to the Old Course in 1837 as the first true example of golf architecture; see Geoffrey Cornish, *Eighteen Stakes on a Sunday Afternoon*, Worcestershire, England, 2002, pp. 2-3.

standardization toward typical lengths of holes and courses; and the simple fact that the Old Course at St Andrews was among the longest courses of the day, if not the longest, likely contributed to the lengthening of new and existing courses.<sup>33</sup>

Toward the close of this era, there was a surge in debate about, and articulation of, golf course design strategy. Importantly, a consensus emerged from these discussions on the essential elements of an ideal test of golf: 1) that a round of golf should require a player to use every club in the bag; and 2) that over the course of a round, a player should be required to demonstrate a full range of skills with these clubs. Many who wrote on the subject shared a strong belief that the length of each hole should be built around the length of one, two or three full shots (and specifically the typical lengths of a full shot by a highly skilled player).<sup>34</sup>

c. Increased Hitting Distances – Finally, it is noted that late 19th-century lengthening of golf courses corresponded with the modest increases in hitting distances for the longest players that occurred between 1880 and 1900. The extent to which increases in hitting distances contributed to course lengthening is not clear; contemporary sources make little reference to this influence (notably different from what transpired shortly after 1900).<sup>35</sup>

d. Discrete teeing areas – The earliest codes of golf rules stipulated that all players tee the ball within a defined number of club lengths from the hole just completed.<sup>36</sup> In 1882 the Royal and Ancient Golf Club of St Andrews became the first club to write into the rules provisions for a separate teeing area denoted by markers. Discrete teeing areas soon thereafter became standard features on all golf courses and there are indications that separate teeing grounds

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<sup>33</sup> Robert Browning, *A History of Golf: The Royal and Ancient Game*, London, J.M. Dent and Sons, 1955, p. 61, suggested that if other clubs had emerged as “the recognized capital of golf” then golf courses would have evolved differently: “If Leith had remained the chief centre of the game, golf might have become a sterner and more monotonous business than it is to-day, for the Leith course was primarily a test of hard hitting; its five holes measured 414, 461, 426, 495, and 435 yards.”

<sup>34</sup> There are many sources that could be cited as references for these observations, particularly in the early 20th century; a compendium of perspectives from leading figures in the game was published in the Appendix (“Distances of the Holes”) of Arnaud Massy, *Golf*, London, Methuen and Company, 1914, pp. 147-154. One of the earliest articulations of this philosophy appears in Garden G. Smith, *The World of Golf*, London, A.D. Innes and Company, 1898, pp. 85-93; giving hitting distances at the time, Smith (p. 85) suggests that “a hole should not be much shorter than 100 yards or longer than 500 yards.”

<sup>35</sup> An interesting exception to this observation are the comments by J.H. Taylor on course lengthening (importantly, this text was written before the advent of the rubber-core ball in Britain) to create more difficult tests for the best players; see J.H. Taylor, *Taylor on Golf: Impressions, Comments and Hints*, London, Hutchinson and Co., 1902, pp. 143-144.

<sup>36</sup> The oldest known code of rules written for the Honourable Company of Edinburgh Golfers in 1744 defined the teeing ground as being within one club length of the [previous] hole. Successive codes for Bruntsfield (1773), St Andrews (1777), Crail (1786), Perth (1825) and others variously defined the teeing ground as being between one and as many as twelve club lengths from the hole; see Kenneth G. Chapman, *The Rules of the Green: A History of the Rules of Golf*, Chicago, Triumph Books, 1997, pp. 95-96; and John Hutchinson, “The Teeing Ground,” [ruleshistory.com/teeing.html](http://ruleshistory.com/teeing.html). It is clear from such rules that all players (regardless of ability or gender) played each hole at the same length; and that hole length was determined solely by the distance that separated the individual holes (i.e., the physical holes in successive putting greens).

were soon created for elite competitions.<sup>37</sup> Of course, in some instances the placement or construction of these teeing areas may have lengthened a hole and in other instances may have shortened a hole; there are no surviving records of such activities that would clarify whether or not this resulted in a general trend toward lengthening or shortening.

e. Courses for women – Golf courses specifically designed for women’s play, as well as golf clubs for women only, first appeared in the late 1860s<sup>38</sup>; by the end of the 1890s, there were at least 30 golf courses for women in the British Isles and the United States.<sup>39</sup> These courses comprised between 6 and 18 holes and ranged in length from about 900 yards to as long as 5000 yards. The majority were nine-hole layouts, typically between 1500 to 2300 yards.<sup>40</sup> The first Ladies’ Golf Championship, won by Lady Margaret Scott in 1893, was played on the 9-hole course at Lytham that measured around 2000 yards for 18 holes.

## Circa 1900 to Early 1930s

### Hitting Distances Circa 1900 to Circa 1930

Hitting distances for men and women increased dramatically at the turn of the 20th century. Historical sources suggest that typical driving distances for most segments of golfers increased by 10-25 yards in the five-year period between 1899-1904, corresponding with the introduction of the rubber-core golf ball. It is notable that there were significant variations in reports of hitting distances across this five-year period, as well as within a given year, reflecting the fact that the transition to the new ball occurred over several years (principally 1900-1903) such that both gutta percha and rubber-core balls were in use concurrently (often by different players within a single event field).<sup>41</sup> Substantive increases in reported hitting distances continued, albeit at a slower pace, between the mid-1900s and the early 1930s.

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<sup>37</sup> For an early reference to back tees, see Garden Smith, *The World of Golf*, London, A.D. Innes and Company, 1898, p. 94: “It is usual to have special medal teeing grounds, in addition to those for ordinary play, and these are generally placed some yards farther back.”

<sup>38</sup> The oldest known women’s course was created at North Berwick, Scotland in 1867.

<sup>39</sup> For a list of early women’s courses, see Keith Cutten, *The Evolution of Golf Course Design*, Glen Waverly, Australia, Full Swing Golf Publishing, 2018, pp. 165-166; many more women’s courses are included in the listings of clubs in various editions of C.R. Bauchope and David Scott Duncan, editors, *The Golfing Annual*, London, Horace Cox Publishers, 1888-1910.

<sup>40</sup> Data for the early women’s courses were found in Issette Pearson, editor, *The Ladies’ Golf Union Annual*, Volume V, Sutton, England, William Pile, 1899.

<sup>41</sup> See, for example, “Oldcastle,” “The Amateur Championship,” *Golf*, New York, October 1901, p. 239: “...the rubber ball fairly shared honors with Mr. Travis...It was rather amusing to be Atlantic Country Club during the few days immediately preceding the tournament, and watch the consternation of the Eastern players as the Western men proceeded to exploit the new ball. Players of whom no one had ever heard were doing the course in record-breaking figures, and the Eastern cracks stood aghast”; as well as “The Amateur Championship of America: A New Ball Creates a Sensation,” *Golf Illustrated: The Weekly Organ of the Royal and Ancient Game*, London, October 4, 1901, p. 8: “[The rubber ball] was first put to practical test in the Onwentsia tournament last August...and all the players who used them carried all before them. So great was the demand and so scarce the supply, that the price rose during the tournament to five dollars for two balls.” Walter Travis was the first player to win a major

The following table summarizes the ranges of reported hitting distances for the key cohorts of golfers circa 1900 and circa 1930.

*Table 2 Ranges of reported hitting distances circa 1900 and 1930.*

Date	Recreational Women	Recreational Men	Elite Women		Elite Men	
			Typical Drives	Long Drives	Typical Drives	Long Drives
<b>Circa 1900</b>	75-100 yards	100-150 yards	120-140 yards	150-170 yards	160-200 yards	200-220 yards
<b>Circa 1930</b>	100-150 yards	130-180 yards	175-225 yards	225-250 yards	220-260 yards	270-290 yards

There are no meaningful differences between the reported hitting distances of male professionals and elite amateurs during this time period between 1900-1930.<sup>42</sup>

### Key Contributors to Distance Circa 1900 to Circa 1930

The increases in hitting distances between the turn of the century and the early 1930s were coterminous with significant improvements to the design and manufacture of golf balls. Foremost among these was the invention of the rubber-core Haskell ball in 1898 (the patent for the new ball was issued April 11, 1899 and soon thereafter it went into production).<sup>43</sup> A review of contemporary literature confirms the immediate and dramatic impact of the Haskell ball, which led to reported increases in driving distance of 10-25 yards for all players.<sup>44</sup> For example, it was reported that U.S and

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championship – the 1901 U.S. Amateur – using a rubber-core ball; that same year, Willie Anderson became the last player to win a major championship using a gutta percha ball – the U.S. Open at Myopia Hunt Club. In the 1902 British Open Championship, Scottish professional Sandy Herd was the only player in the field to use the new ball; using a single rubber-core ball for 72 holes, he won the championship by a single stroke over Harry Vardon and James Braid, who combined had won seven of the eight previous Opens.

<sup>42</sup>A with the previous era, note again that there was no cohort of female professionals during this time period from 1900-1930.

<sup>43</sup> Much has been written on the invention of the rubber ball in 1898 by Coburn Haskell and Bertram Work and the subsequent controversy; a concise summary of key events is provided by Peter Lewis, “The History of the Golf Ball in Britain,” in Alastair Cochran, editor, *Golf: The Scientific Way*, Hemel Hempstead, U.K., Aston Publishing Group, 1995, pp. 168-170.

<sup>44</sup> In 1902 and 1903, many articles, editorials and letters were published in prominent British and American periodicals both extolling and excoriating the increases in hitting distances that were possible with the new ball. Many of these same sources report 10-25 yard gains with the Haskell ball for virtually all players; see, for example, “Golf and the New Ball,” *Blackwood’s Magazine*, Edinburgh, Scotland, September 1902, pp. 363-374; “Symposium Upon the Bounding Billy,” *Golf*, New York, October 1902, pp. 238-241; and A.H. Doleman, “The Rubber-Ball Controversy,” *Golf Illustrated: The Weekly Organ of the Royal and Ancient Game*, London, January 30, 1903, pp. 92-93. Late in 1901, J. Sutherland, Hon. Secretary of the Dornoch Golf Club, conducted tests with three different gutta percha balls and the new rubber ball, reporting that the new ball consistently outdistanced the gutta percha ball by



British Amateur champion Walter Travis improved his average driving distance by 25 yards (from 175 yards to 200 yards) when he switched from a gutta percha ball in 1899 to a Haskell ball in 1900.<sup>45</sup> Some contemporary observers noted that the increases in hitting distances were even more pronounced with iron clubs.<sup>46</sup>

While the original Haskell ball itself led to significant increases in hitting distances, subsequent improvements to the design and manufacturing of rubber-core balls in the decades that immediately followed further increased hitting distances for all cohorts of players.<sup>47</sup> The legendary champion Harry Vardon, for example, claimed that if the first Haskell ball had put twenty yards on his drives, “the latest types of rubber cores have added about forty yards to the length obtainable with the Haskell...without the aid of wind or sloping ground.”<sup>48</sup> A 1921 article in the *New York Times* reported that “longer hitters

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9 to 17 yards; on this test, see “Through the Green,” *Golf*, New York, January 1902, p. 54. Contemporary sources record that the concern about the new ball centered around two primary issues: that the character of the game was being compromised; and that courses were being rendered obsolete. On the former concern, see especially the writings of John Low, *Concerning Golf*, London, Hodder and Stoughton, 1903 and John Low, “Golf and the Man,” in Garden G. Smith and Harold H. Hilton, editors, *The Royal and Ancient Game of Golf*, London, London & Counties Press, 1912, pp. 57-72.; on the latter concern about golf course obsolescence, see for example the remarks of USGA President R.H. Robertson at the USGA’s seventh annual meeting, February 27, 1902: “The character of the game has been somewhat affected by the modern appliances that have followed – with wooden faced iron clubs and iron faced wooden clubs and wound-up rubber balls, the bunkers of our forefathers are no longer a matter of any concern or terror to us... If the game continues to improve in the matter of its length... the game in the future will be relegated to the only place where it can be played, and that is on the great prairies of our Western country” (from original transcript in collection of USGA Library). In England, such was the concern of the Professional Golfers’ Association that the new ball was taking skill out of the game that they approached The R&A with a request to bar the rubber ball from the Open Championship. On the benefits of the new Haskell ball for the typical recreational player, see Dr. J.G. McPherson, “The Rubber-Cored Ball,” *Golf*, New York, November 1902, pp. 312-313.

<sup>45</sup> John Stuart Martin, *The Curious History of the Golf Ball*, New York, Horizon Press, 1968, p. 57. In addition to the benefits of the rubber ball that were noticed immediately by leading player like Travis, there were notable tests of the rubber ball against gutta percha balls in later years; for example, during an exhibition match in England in 1914, four leading players (including James Braid and George Duncan) hit drives using both balls – Braid’s longest drive with the rubber ball was 278 yards and 225 yards with the gutta percha, Duncan’s longest drive with the rubber ball was 268 yards and 240 yards with the gutta percha ball; see “Test of the Guttie Ball,” *The Golfers Magazine*, Chicago, April, 1914, pp. 57-58.

<sup>46</sup> Although never systematically measured, it was reported by many contemporary sources that the new rubber ball led to modest incremental carry distance, but even more so increased roll as the new ball bounced significantly more when it landed, hence the common contemporary acronym “Bounding Billie”; see, for example, “Through the Green,” *Golf*, New York, January 1902, p. 54. While it is difficult to assess the reliability of each source, many contemporary reports suggested that hitting distances with iron clubs were often around 20 yards, with one report even making the claim that hitting distances increased 30 yards or more; “Symposium Upon the Bounding Billy,” *Golf*, New York, October 1902, pp. 238-241.

<sup>47</sup> Continuous improvement in the manufacture and performance of the rubber ball was noted by numerous contemporary authors. See for example the article by noted Pine Valley Golf Club architect George Crump, “Standard Golf Ball: Expert Says ‘Liver’ Balls Make Courses Worthless,” *The Times-Dispatch*, Richmond, Va., April 22, 1917, p. 29: “the golf ball makers each year are turning out new balls that can be driven further than the balls used the year previous, and, as every golf likes to hit the ball far, each improved ball has that many advocates.”

<sup>48</sup> Harry Vardon, *How to Play Golf*, London, Methuen and Co., 1912, p. 21

are getting greater distance than ever before; short hitters are finding their drives improved to the extent of twenty yards or so.”<sup>49</sup>

As noted earlier, the lack of controlled measures of distance and ball performance hinder an ability to associate discrete distance increases with specific innovations in ball design and manufacture.

Nonetheless, it is possible to identify the improvements that were made during these decades that may have affected hitting distances:

- a) Improvements in cover materials (the original Haskell ball had a gutta percha cover, but within a matter of years balata covers were used); reductions in cover thickness; and improved methods for adhering cover to core (including the introduction ca. 1910 of vacuum technologies to remove excess air from the core).
- b) Improvements to cover patterns, including a bramble pattern ca. 1900; the invention of the dimple cover pattern in 1905 by William Taylor; and the introduction of square and lattice cover patterns by Albert E. Penfold in 1912.
- c) Improvements in golf ball core winding processes (including tensioning devices and modified winding machines) together with improved tensile strength of the rubber tape and threads used to form the core; the earliest Haskell balls comprised 820 feet of rubber thread under tension, but by 1908 comprised more than 1150 feet of rubber thread under tension.
- d) The evolution of center materials initially from rubber tape or thread to solids (ebonite, India rubber, metal, cork); and eventually to liquid compounds (including experiments with glycerin, honey, castor oil, mercury and most commonly water, including water frozen with dry ice) and air (pneumatic cores).<sup>50</sup>
- e) Variations in size and weight of golf ball models prior to the establishment of the first regulations (see below). Before 1915, manufacturers experimented with optimal combinations of size and weight to maximize distance, first by increasing weight, then by reducing both size and weight. Between 1915-1919, there were at least 15 variations of size and weight on the market, including small and heavy balls for play into the wind, as well as large and light balls for play downwind (players having the ability within the Rules of Golf to change a golf ball on each hole, if desired).<sup>51</sup>
- f) Machine testing of golf balls introduced in 1913 to test product post-manufacturing and reject balls for poor distance performance; similarly, beginning in 1920, X-ray testing of golf balls to prove true and round centers.

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<sup>49</sup> “Golf,” *New York Times*, March 7, 1921, p. 12

<sup>50</sup> Scottish professional Jack Jolly is credited with creating the first liquid-core golf ball in 1902.

<sup>51</sup> On variation in golf ball specifications, see Herbert Jacques, “What is the New Ball?” *American Golfer*, Greenwich, Conn., June 1929, p. 13; the first Haskell balls measured 1.71” in diameter and weighed 1.55 ounces. Charles Blair Macdonald, *Scotland’s Gift, Golf*, New York, Charles Scribner’s Sons, 1928, pp. 281-282, discussed the variations in golf ball specifications in 1911, providing a partial list of balls on the market at the time with 22 variations of size (at increments between 1.625”- 1.72”) and weight (at increments between 1.40 and 1.72 ounces).

A.E. Penfold, a golf ball designer and engineer working at the time for Dunlop Rubber Company, claimed in an article published in *Golf Illustrated* in 1924 that these various innovations combined to add about 30 yards of driving distance in comparison to the initial Haskell ball.<sup>52</sup>

Following on the heels of considerable evolution and improvement in golf ball design and manufacture – and performance – the USGA and the Royal and Ancient Golf Club of St Andrews (hereafter, “The R&A”) first implemented regulations on golf ball size (1.62”) and weight (1.62 ounces) that went into effect on May 1, 1921.<sup>53</sup> Following a failed experiment by the USGA in 1931 with a golf ball that was large (no smaller than 1.68”) and light (no heavier than 1.55 ounces) – the so-called “balloon ball”<sup>54</sup> – the USGA and The R&A in 1932 reached a compromise on a golf ball that would weigh no less than 1.62 ounces, with a variation in size of either no smaller than 1.62” (R&A) or 1.68” (USGA).

While improvements to the design and manufacture of golf balls likely contributed most to increases in hitting distances during this time period, it is possible to identify other contemporary developments that could have had an impact on hitting distances as well. It should be emphasized that the impact on hitting distances was not always consistent and not always meaningful for every golfer or at every golf course; for example, improvements in irrigation and agronomic conditions on some golf courses may have resulted in increases in hitting distances, while on other courses may have resulted in decreases. The list that follows makes no attempt to differentiate between the developments that were significant or trivial for distance increases, nor to identify which developments acted alone or in concert with others to influence hitting distances, but rather is intended to show that there were many innovations that influenced distance during these decades:

- a) Driver – Continued evolution and refinement of the driver, including considerable experimentation with clubhead and clubface-insert materials (varieties of wood, including

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<sup>52</sup> A.E. Penfold, “The Modern Ball: Changes that make for increased length,” *Golf Illustrated: The Weekly Organ of the Royal and Ancient Game*, London, November 28, 1924, p. 199; Charles Blair Macdonald, *Scotland’s Gift, Golf*, New York, Charles Scribner’s Sons, 1928, pp. 280-281, presented a similar analysis, but concluded that the original Haskell added 25-30 yards and that subsequent improvements after 1904 added about 12 yards.

<sup>53</sup> The debate about the need for a standardized ball had first been taken up by the USGA in 1912, but these discussions were halted by the onset of World War I. Following the war, the debate resumed on both sides of the Atlantic, as both the USGA and The R&A started to revisit the topic in 1919 in discussions that would eventually lead to the first regulations in 1921. In the years that immediately followed, the USGA and The R&A each conducted tests with golf balls of various sizes and weights, meanwhile continuing discussions about standardization of the golf ball. A comprehensive overview of the history of golf equipment regulation is provided by Frank Thomas and Valerie Melvin, *From Sticks and Stones: The Evolution of Golf Equipment Rules*, Reunion, Fla., Frankly Publications, 2001.

<sup>54</sup> With its lighter weight relative to size, the new ball did not have a penetrating flight (comparatively) and seemed to float in the air (hence the name, “balloon ball”); the USGA estimated at the time that it would reduce driving distance by 2-3%. Soon after it went into effect, golfers began to protest that the ball was too susceptible to wind and that it veered offline on putts, particularly as it lost speed; see Herbert Jacques, “What is the new ball?” *American Golfer*, Greenwich, Conn., June 1929, p. 13. On public sentiment regarding the new “balloon ball,” see “More News of the Great Golf Ball War,” *The Literary Digest*, New York, July 11, 1931, p. 34; and “Letters from Subscribers on the New Ball,” *Golfers Magazine*, Chicago, August 1931, p. 50.

compressed wood and laminates, as well as metal alloys), clubhead size and shape (notably including oversize heads), and improved socket joints.<sup>55</sup>

- b) Irons – Continued evolution and refinement, including differential weighting of clubheads (i.e., the addition and or redistribution of mass on back of clubhead, which had the potential to increase both mass and moment of inertia).
- c) Shafts – Evolution and experimentation in dimensions and materials, including the introduction of hollow steel shafts (early 1910s).<sup>56</sup> The introduction of the rubber ball coincided with an evolution toward thicker shafts, together allowing players to swing more aggressively without fear of breaking a clubhead or a shaft.<sup>57</sup>
- d) Golf tee – The sand tee common in the early centuries of the game was replaced in the early 20th century by tees made of paper, rubber, celluloid and, eventually and most importantly, wood (which quickly grew in length); the ability to elevate the ball above the turf corresponded with changes in club design and swing technique.<sup>58</sup>
- e) Golf spikes – Enhancements and widespread adoption of purpose-designed golf shoes with metal spikes (which had first appeared in the late 19th century but were not widely used); early sources referenced improved traction and stability, leading to changes in swing technique.<sup>59</sup>
- f) Clothing – In both the United Kingdom and the United States, typical golf attire for men and women evolved rapidly after the turn of the century, becoming less restrictive in nature with lighter materials and fewer layers; the new fashion facilitated a longer backswing, a full turn and a more forceful and flowing swing.<sup>60</sup>
- g) Agronomic conditions – The first scientific research on golf course turfgrass, with the aim of improving the quality of playing surfaces, was initiated in the early 1900s by Dr. C.V. Piper and

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<sup>55</sup> An extensive commentary on the evolution of golf clubs (woods and irons) in the decade following the introduction of the Haskell ball was provided by Percy H. Whiting, "The Present Trend in Golf Club Design," *Golf*, New York, May 1913, pp. 313-317.

<sup>56</sup> The USGA and R&A initially ruled steel shafts illegal for play in competition, yet manufacturers and retailers continued to offer clubs with steel shafts due to increasing shortages of high-quality old-growth hickory.

<sup>57</sup> Percy H. Whiting, "The Present Trend in Golf Club Design," *Golf*, New York, May 1913, p. 316

<sup>58</sup> On the history of the golf tee, see Irwin R. Valenta, *The Singular History of the Golf Tee*, no location, self-published, 1995.

<sup>59</sup> On the practice and benefits of spiked shoes for golf, see for example Harry Vardon, *The Complete Golfer*, London, Methuen, 1905, pp. 166-167.

<sup>60</sup> See Rhonda Glenn, *The Illustrated History of Women's Golf*, Dallas, Texas, 1991, pp. 21-39; Malcolm Crane, *The Story of Ladies' Golf*, London, Stanley Paul and Company, 1991, pp. 144-146; Lewine Mair, *One Hundred Years of Women's Golf*, Edinburgh and London, Mainstream Publishing, 1992, pp. 41-42; and David Stirk, *Golf – History & Tradition, 1500-1945*, Excellent Press, Ludlow, UK, 1998, pp. 283-284. For a contemporary source, see Mary E.L. Hezlet, "Dress for Golf," *C.B. Fry's Magazine*, London, December 1906, pp. 230-234; "Dress for Lady Golfers," *C.B. Fry's Magazine*, London, January 1907, pp. 370-372; Dorothy Campbell Hurd, "Improvement in Women's Play, 1914-1929," *Golf Illustrated: The Weekly Organ of the Royal and Ancient Game*, London, March 1929, p. 30: "First and foremost is the freedom to the limbs and muscles that the present style of dress allows its wearers." On the evolution of men's clothing, see for example the chapter on "Dress" in D.G. Soutar, *The Australian Golfer*, Melbourne, Australia, E.W. Cole, 1908, pp. 132-134.

Dr. R.A. Oakley of the United States Department of Agriculture. Through their efforts, scientific papers on golf course agronomics were first published in 1913. Thereafter, supported by an expanding community of researchers, continuous improvement in turfgrass science gradually improved the agronomic health of golf course turfgrass, further spurred in the 1920s by the establishment of the USGA Green Section (1920), the National Association of Greenkeepers of America (1926, today known as the Golf Course Superintendents Association of America), and the Sports Turf Research Institute in England (1929).<sup>61</sup>

Improvements to golf course irrigation practices and technology paralleled these advances in agronomic science. Historical records indicate that horse-drawn carts were used to irrigate golf courses (typically only putting greens) as early as the middle of the 19th century, but the practice of irrigating fairways did not become common until the early decades of the 20th century, typically by hand and using horse-drawn carts; if moderate to severe droughts occurred, fairways became very firm and widespread turf loss often occurred.<sup>62</sup>

Finally, significant advancements in the design of mowing equipment occurred in the closing decades of the 19th century, but were not widely adopted in golf until the early decades of the 20th century; most importantly, these included horse-drawn gang mowers and mowing reels with cutting heights that gradually diminished to less than 1" and perhaps as low as 0.75". The early 1920s witnessed the replacement of horses with tractors, capable of pulling five and sometimes as many as seven gang mowers across the fairway, which significantly eased and reduced the time for mowing fairways.<sup>63</sup>

The combined impact of these three factors would have varied from course to course. On courses where improved turf and/or improved irrigation replaced hard surfaces, bounce and roll would have been diminished; lower mowing heights, on the other hand, would have promoted additional roll.

- h) Swing technique – After 1900, swing techniques evolved to favor a draw or hook shot (for right-handed players) which imparted less backspin and produced more roll, and thus was more compatible with the rubber ball (as noted above, swing techniques in the latter decades of the 19th century targeted maximized carry, as the solid gutta percha ball generated minimal roll).<sup>64</sup> Also during this time, the merits of learning to swing aggressively at a young age were recognized and advocated by leading instructors.<sup>65</sup> Concurrently, the understanding of swing

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<sup>61</sup> On the history and evolution of golf course agronomy as a scientific discipline, see T.T. Taylor, "Turfgrass – Its Development and Progress," *USGA Journal and Turf Management*, New York, September 1957, pp. 28-32.

<sup>62</sup> SU02 – The Evolution of Fairway Agronomy, p. 5

<sup>63</sup> SU02 – The Evolution of Fairway Agronomy, p. 1

<sup>64</sup> Kevin McGimpsey, *The Story of the Golf Ball*, Philip Wilson Publishers, London, 2003, p. 57; see also Brownlow Wilson, "Long Hitters of All Time," *Golf Illustrated*, New York, May 1934, pp. 14-15, who noted that hitting a gutta percha ball long distances required sheer strength, while the rubber-core ball could be driven farther with perfect timing alone.

<sup>65</sup> See for example Glenna Collett, *Golf for Young Players*, Boston, Little Brown, 1926 and Francis Ouimet, *Golf Facts for Young People*, New York, Century, 1921; exposure to the game was offered through caddie programs at many clubs, as well as educational institutions, including many elite colleges that built golf courses on campus and established teams in the late 1890s and early 1900s.

mechanics advanced significantly through the use and widespread availability of slow-motion photography and film.<sup>66</sup>

Having considered such an extensive list of potential contributors to distance during the early 20th century, it should be emphasized that there is no way to isolate and quantify the material contribution to increased hitting distances from each of these individual developments. Further, many of these individual developments worked in combination with one another to impact distance. Nonetheless, there are clear indications that these developments, alone or in combination, had a role in distance increases that were recognized at the time.

### The Evolution of Golf Course Lengths Circa 1900 to Circa 1930

The expansion in golf participation and the resulting surge in course building that started in the 1890s accelerated in the first decade of the 20th century.<sup>67</sup> At the same time this was happening, the new rubber-core ball was leading to substantive increases in hitting distances, as also incrementally did other contemporary advances in equipment, course conditioning and swing technique that would continue over the next 30 years.

By the early 1930s, the median length of golf courses was around 6200 yards (noting that golf courses in the United States were marginally longer than courses in the British Isles); and the longer golf courses were typically around 6600 yards. Courses used for elite male competitions averaged around 6700 yards and courses for elite female competitions averaged around 6400 yards (see H09 – Analysis of the Evolution of Golf Course Lengths).<sup>68</sup>

An analysis of historical source materials suggests that the following developments influenced golf course lengths over this time period:

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<sup>66</sup> See for example Dorothy Campbell Hurd, "Improvement in Women's Play, 1914-1929," *Golf Illustrated*, New York, March 1929, p. 30: "What a much better kind of instruction can be had today when the slow moving pictures have revealed to us the exact motions of the great ones of the golfing world during the process of their swing. Instead of blindly groping in the dark for reasons of errors that have crept in on us like 'an envious sneeping frost' we can release the reels of pictures of our own swing and check up exactly how we made shots when we delighted ourselves." The first instruction book to make extensive use of still photography was written by (U.S. Open, British Open and PGA champion) James M. Barnes, *Picture Analysis of Golf Strokes*, Philadelphia, J.B. Lippincott, 1919. Henry Cotton later articulated more precisely the value of the new technology, noting that "the slow-motion cinematograph 'burst open' positively a number of theories, particular the one that a perfect swing was a true circular motion, whereas in fact the swing was found to be a looping action;" see Henry Cotton's essay on "Styles and Methods" in Bernard Darwin et al., *A History of Golf in Britain*, London, Cassell and Company, 1952, pp. 120-121.

<sup>67</sup> When the USGA was founded in 1894, there were estimated to be fewer than 100 golf facilities and around several thousand golfers in the United States. Though the number of golfers in the United States from 1895 to 1920 varies greatly by source, most report the game "growing by thousands" with each subsequent year and reaching the one million mark between 1914 and 1920. The total number of golf courses reported increased from 783 courses in 1900 to 1224 golf course in 1917, to 3690 courses in 1930.

<sup>68</sup> There should be a caveat for the women's yardages; the average par for the courses during the 1930s was 78.3. The average yardage fell gradually until the 1970s, when the average was 6094 yards, before rising again. It was not until the 2010s that the average reached the 6400-yard mark again.

- a) Increased Hitting Distances – The pressures caused by increased hitting distances on existing golf courses were felt immediately and these pressures were quickly and widely discussed and debated across the golf community. As early as February 1902, USGA President R.H. Robertson declared:

“The character of the game has been somewhat affected by the modern appliances that have followed – without wooden faced iron clubs and iron faced wooden clubs and wound-up rubber balls, the bunkers of our forefathers are no longer a matter of any concern or terror to us... If the game continues to improve in the matter of its length... the game in the future will be relegated to the only place where it can be played, and that is on the great prairies of our Western country.”

In October 1902, the editors of *Golf* were polling readers to ask if the new rubber-core ball added length to their drives, if it played better than the gutta percha ball, if it disproportionately improved the play of different calibers of players, and if it spoiled the present courses.<sup>69</sup> John Low, a distinguished member of The R&A's Rules of Golf Committee, railed against the new ball in his 1903 book, *Concerning Golf*, claiming that the rubber-core ball compromised the importance of skill in the game, “by practically shortening courses.”<sup>70</sup>

But the impact of the rubber-core ball was not simply to stir up controversy and debate; contemporary sources confirm equally that the rubber-core ball's effect on hitting distances was the primary reason for actual course lengthening during the years immediately following its adoption. A 1906 *New York Times* article asserted that “In the last three years American links have been made progressively more difficult. This increase has been made necessary by the rubber-cored ball, which has enormously increased the power of driver and brassie to give length.”<sup>71</sup>

Likewise, an article in *Golf* highlighted the recent “tendency to lay out courses of extraordinary length,” while noting that “the more conservative are claiming there is need for calling a halt [to further increases in driving distance], else the necessity for remodeling all the present courses will be imperative.”<sup>72</sup>

Within just a few years of the new ball's popularization, reports on golf course construction regularly mentioned the inadequacy of courses designed prior to the rubber-core ball. As one 1904 report of a new course opening noted that, “It is undeniably true that the courses accounted of sufficient length in this country for the hard ball have proved too abbreviated for the livelier sphere”; of particular significance is that this new course, designed by Tom Bendelow to “allow free use of one's golfing strength in the driving, approaching and putting... with the

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<sup>69</sup> “Symposium Upon the ‘Bounding Billy,” *Golf*, New York, October 1902, p. 238

<sup>70</sup> John L. Low, *Concerning Golf*, London, Hodder & Stoughton, 1903, p. 11

<sup>71</sup> “The Golf Championship,” *New York Times*, July 15, 1906, p. 8; the article claims that courses in 1906 were 1000 yards longer than those in use before 1900 due to the rubber-core ball.

<sup>72</sup> Alexis H. Colman, “Western Department,” *Golf*, New York, June 1907, pp. 337-338

rubber-cored ball," measured 6827 yards (making it, perhaps, the longest course in the world at the time).<sup>73</sup>

As the design and manufacturing of the rubber-core ball improved over the three decades following its introduction, resulting increases in hitting distances continued to place pressure on course lengths. 1910 heralded the widespread introduction of balls in the U.S. and Great Britain which were smaller, heavier and more tightly wound than anything seen so far. That same year, *Golf Illustrated* reported that, "If the carrying power of the ball is to be still further increased, all our golf courses will be irretrievably ruined as a test of the game."<sup>74</sup> Likewise, in 1911, *Golf* suggested that, "There can be no blinking the fact that an all-around lengthening of the drive has taken place recently, until it now begins to look as if it will not be worth while playing golf on anything but a course of 6000 yards or upward."<sup>75</sup> When the Haskell patent expired in 1915, competition to create better, longer golf balls further increased, and many of the game's most powerful influencers voiced concern over golf balls continuing to fly farther and farther: "The air is even now full of rumors of new balls that will still further eliminate space, still further flatter incapacity, still further spoil courses and embarrass green committees. [Harry] Vardon thinks it is only a matter of a few years before 400 yards is will be the accepted length for a one shot hole."<sup>76</sup>

In 1927, golf architect William Flynn warned of a future when golf courses could reach 8000 yards due to the increased distance.<sup>77</sup> Such sentiments were shared by many in the golf community, including the governing bodies who (as detailed above) took steps to regulate the golf ball. Writer O.B. Keeler contended that new golf ball specifications contemplated in the late 1920s (the so-called "balloon ball") "may be expected to bring the proper length of a championship course down to 6400 or 6500 yards, instead of the 6900 to 7000 thus vastly increasing the number of courses suitable to major competitions."<sup>78</sup>

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<sup>73</sup> Alexis J. Colman, "Western Department," *Golf*, New York, February 1904, p. 120. The same concerns were highlighted regarding the appropriate length of golf courses for women; see the chapter on "Courses for Women" in Genevieve Hecker, *Golf For Women*, New York, The Baker and Taylor Company, 1902, pp. 198-201, written within a year of the popularization of the rubber-core ball, who noted that holes that used to require two full shots with a wooden club could now be played with a drive and one iron shot. Hecker (p. 199) argued that such changes were detrimental to the game for it spoiled the advantage of the long drive: "It is the sort of thing which breaks a good player's heart." Further, Hecker (pp.203-204) described the ideal course for an elite female player, measuring 5984 yards.

<sup>74</sup> As quoted in Frank Thomas with Valerie Melvin, *From Sticks and Stones: The Evolution of Golf Equipment Rules*, Reunion, Fla., Frankly Publications, 2001, p. 17

<sup>75</sup> "Through the Green," *Golf*, New York, October 1911, p. 248. It is interesting to note that, in the same year that this article appeared, increases in hitting distances and course lengths led to modifications in the USGA Handicap System guidelines for the par values of holes. In 1897 the maximum distance was set at 165 yards for a par-3 hole, 310 yards for a par 4, and 450 yards for a par 5. In 1911, those yardages were increased to 225, 425, and 600 yards. Another adjustment was made six years later, when the par-3 maximum distance increased to 250 yards, and the par-4 distance to 445 yards. The next change came in 1956, when the par-4 distance increased to 470 yards.

<sup>76</sup> "Harry Vardon the Master Golfer Regrets Decadence of the Game." *The Times-Democrat*, New Orleans, Louisiana, May 18, 1913, p. 50

<sup>77</sup> William Flynn, "Golf Architecture and Construction, Designing the Course, Part I," *The Bulletin of the United States Golf Association Green Section*, Washington, D.C., August 1927, p. 159

<sup>78</sup> O.B. Keeler, "The Duffer Will Like the Larger Ball," *Thirty-Second National Open Championship Souvenir Book*, Chicago, Olympia Fields Country Club, 1928, pp. 23.



- b. Competitive Market Forces – A commentary that emphasized the impact of the rubber-core ball on increasing course lengths was penned by Cecil Barcroft, a member of the Royal Dublin Golf Club in Ireland, in an article that appeared in *The Golfers Magazine* in 1907:

“The purpose of this article is to discuss the ravages which the rubber core has made on our links by making them easier... The rubber core simplifies golf in three ways. It adds length to the shot, especially from iron; it rises much more quickly than the gutta, making bad lies more easily negotiated; and above all it goes a very long way when very badly hit. To make golf as skill a game as the with the gutta (an impossibility in the writer’s opinion), our courses must be made more difficult. This has been attempted by most committees by bringing in new ground or rearranging holes so as to add from two to four hundred yards... There is no doubt that the additional length given by the rubber-core rendered some lengthening of our courses necessary; but the craze for lengthening courses is fast becoming a mania... There seems to be an unholy struggle among green committees to get length, and an unholy pride in the possession of a very long course.”<sup>79</sup>

Barcroft’s closing thought is of note, for it introduces another driver of course lengthening through time – “pride in the possession of a long course” – which might otherwise be characterized as a reaction to competitive market forces. The perception that a longer course is better is certainly related to the 19th-century tendencies toward imitation and standardization, but now with the added dimension of competition.<sup>80</sup> Equally significant was the emergence at this time of the concept of the “Championship Course,” which also tended to promote longer courses.<sup>81</sup> Naturally, it is difficult to quantify the impact (in yardage) of competition on course lengthening at any time in history. That said, the rapid growth in the

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<sup>79</sup> Cecil Barcroft, “The Craze for Lengthened Courses,” *The Golfers Magazine*, Chicago, October, 1907, pp. 274-275; it is also interesting that the author suggested making the courses more difficult by narrowing fairways, keeping the greens comparatively small, and putting hazards close to them – otherwise, he noted, “the modern course, with the rubber-core, is fast tending towards testing little but hitting and putting.”

<sup>80</sup> For a contrarian perspective (to standardization), see Robert Hunter, *The Links*, New York, Charles Scribner’s Sons, 1926, p. 150: “The standardization of our golf courses has gone on apace in recent years. It has brought so much value that few of us have thought to question its utility in all cases. The length of the course, the types of the bunkers, the moulding of the greens, the placing of the hazards, the sequence of the holes, etc., are made to follow certain models. That a course must be either of nine or eighteen holes is one of the most ancient of these standards, and the person who questioned its wisdom in all cases would, I fear, be looked upon as one demented. And yet why should every club, regardless of its membership, its funds, and the land available, feel that it must have either nine or eighteen holes?”; and further, p. 151-152: “In order to get to the standard length for the full eighteen we are also committing some stupid blunders. That we must have a course of at least 6,300 yards is becoming a fixed idea. Such courses are referred to sometimes as courses of championship caliber, as if length alone were sufficient to qualify in that class. Not infrequently, as a matter of fact, quality is sacrificed in order to get length... It is refreshing now and then to find a club which has ignored the race for length and gone in for quality.”

<sup>81</sup> One of the earliest definitions and explanation of the concept of the “championship course” was provided in Harold Hilton’s essay on “The Championship Courses” in Horace G. Hutchinson, *Golf Greens and Green-Keeping*, London, Country Life, 1906, pp. 172-173. A further important discussion of the “Championship Course” (for the author, synonymous with “ideal”) was provided by George C. Thomas, Jr., *Golf Architecture in America, Its Strategy and Construction*, Los Angeles, The Times-Mirror Press, 1927, pp. 14-29; and especially pp. 26-29: “no test is of true Championship value unless it has proper length... Roughly speaking, anything under 6,300 yards is a short course for the present-day golf ball, and unless it has great character, must fall short of the Championship ideal.”

number of golf facilities in the U.S. and UK in the early 20th century would suggest that competition for customers and members was increasing in some markets at this time.

- c. Continued Standardization to 18 Holes – While the game had evolved by 1890 to the point where 18 holes was considered standard for a golf course, it would be another 30 years until the number of 18-hole courses exceeded the number of 9-hole courses in the British Isles. As such, the simple act of expanding to 18 holes continued to drive course lengthening well into this era.<sup>82</sup>
- d. Participation Growth – Growing participation led to increases in course lengths in certain markets where demand from surging participation was extreme. For example, Jackson Park, the oldest public golf course in Chicago, increased both the number of holes and total yardage several times between 1903 and 1905 to keep up with demand.<sup>83</sup> The original 9-hole course measured 1700 yards and on occasion players were forced to wait over two hours to tee off.<sup>84</sup> By 1906, the 9-hole course measured 2800 yards and recorded 40,000 rounds and the new 6190-yard, 18-hole course recorded 87,000 rounds.<sup>85</sup>
- e. The Role of the Golf Course Architect – Many of the country's earliest courses were rudimentary layouts built on pastures and orchards. Some early professionals, who made equipment, taught lessons and played competitively, also served as golf course architects, as did some of leading amateurs of the day; the design philosophies of the elite-player-turned-architect often stressed the need to challenge strong players and thus tended to emphasize length.<sup>86</sup> The modern golf industry and many of its subsequent areas of specialization, and of specific relevance to this study the profession of golf course architect, developed between 1910 and 1930.<sup>87</sup> Fueled by

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<sup>82</sup> See Peter Lewis, *Why Are There Eighteen Holes?*, St Andrews, Scotland, The Royal and Ancient Golf Club of St Andrews, 2016, pp. 209-210, who noted that the number of 18-holes courses in Great Britain and Ireland at last reached 51.4% in 1923.

<sup>83</sup> Alexis J. Colman, "Western Department," *Golf*, New York, December 1904, p. 345; further on the relationship between congestion and lengthening, see the account of an unspecified municipal course in George C. Thomas, Jr., *Golf Architecture in America, Its Strategy and Construction*, Los Angeles, The Times-Mirror Press, 1927, p. 4.

<sup>84</sup> "Through the Green," *Golf*, New York, July 1901, p. 60

<sup>85</sup> Alexis J. Colman, "Western Department," *Golf*, New York, April 1905, p. 223

<sup>86</sup> The first golf professional to articulate (in writing) his thoughts on golf course design was the Scottish professional Willie Park, Jr.; see "Laying Out and Keeping Golf-Links" in William Park, Jr., *The Game of Golf*, London, Longmans, Green and Co., 1896, pp. 193-213. For an example of elite amateur architects, see "The Construction and Upkeep of Courses" in Walter J. Travis, *Practical Golf*, New York, 1901, pp. 145-158 (see especially pp. 148-153, where Travis describes an ideal course of 6090 yards). Other detailed descriptions of an ideal golf course, including lengths of each hole, were provided by James Braid, *Advanced Golf*, London, Methuen and Co., 1908, pp. 243-253 (Braid's ideal course totaled 6240 yards); Harry Vardon, *How to Play Golf*, London, Methuen and Co., 1912, pp. 31-37 (Vardon's ideal course totaled 6200 yards); and Charles Blair Macdonald, *Scotland's Gift, Golf*, New York, Charles Scribner's Sons, 1928, pp. 170-185 (the inspiration for the National Golf Links of America, Macdonald's ideal course measured 6017 yards). H.S. Colt, "Golf Architecture" in Martin H.F. Sutton, *The Book of the Links, A Symposium on Golf*, London, W.H. Smith and Son, 1912, p. 75-76, emphasized the difficulty of the courses created by these players, noting "Some years ago it was a very common idea that the first-class player was the only person to be considered when the course was laid out," but rued the result that "Courses have no doubt been getting more and more difficult for the average player."

<sup>87</sup> The role and value of the golf course architect was most clearly articulated and argued in several important monographs on the subject that appeared in the 1920s; see, for example, Alister MacKenzie, *Golf Architecture*, London, Simpkin, Marshall, Hamilton, Kent and Co., 1920; H.S. Colt and C.H. Alison, *Some Essays on Golf Course-*

new technology, improved building methods and increased investment in the game, golf course architects further refined construction processes and design theories. Of note, many of the most influential architects of the 1920s discouraged the trend toward length, noting that many of the game's best tests could be found on golf courses of average length.<sup>88</sup>

- f. Multiple tees – Many golf courses in the early 1900s were constructed with multiple teeing areas (typically a forward teeing area for women's play and in some instances a back tee for tournament play; and further, on some but generally not all holes, primarily dependent upon the requirement of a forced carry) and many golf course architects espoused the creation of multiple teeing grounds to allow for flexibility or to accommodate players of different abilities.<sup>89</sup>

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*Architecture*, London, Country Life and George Newnes, 1920; Robert Hunter, *The Links*, New York, Charles Scribner's Sons, 1926; and George C. Thomas, Jr., *Golf Architecture in America, Its Strategy and Construction*, Los Angeles, The Times-Mirror Press, 1927. On the value of a golf course architect from someone outside the profession, see, for example, (J. Lewis Brown), "Quit Experimenting," *Golf Illustrated*, New York, January 1925, p. 9.

<sup>88</sup> See, for example, H.S. Colt and C.H. Alison, *Some Essays on Golf-Course Architecture*, London, Country Life and George Newnes, 1920, p. 15: "It will probably be agreed that most of the interesting courses are not much longer than 6,300 yards in total length, or much shorter than 5,800 yards, and although much depends on the amount of run which is likely to develop, it may generally be held that a course which measures about 6,000 yards is well off in regard to length."; and Robert Hunter, *The Links*, New York, Charles Scribner's Son, 1926, p. 36: "The longest courses these days are about 6,800 yards in length, and it is impossible to foresee what the ultimate limits are to be...it is well to clearly have in mind whether or not you wish to enter the race for yardage. It is a difficult question. Some of the best courses in this country and abroad are the short ones. The most famous in Great Britain is at North Berwick, and I am quite sure that most good golfers would rather play there than on many long, tiresome, featureless courses with a thousand more yards." British architect Tom Simpson placed a firm upper limit on course lengths for his designs noting, "For myself, I have always refused to lay out a course that measured more than 6350 yards from the back tees and I shall continue to do so"; Tom Simpson, "Golf Architecture" in *The Game of Golf, The Lonsdale Library Volume IX*, London, Seeley, Service and Co., 1931, p. 174.

<sup>89</sup> See, for example, H.S. Colt and C.H. Alison, *Some Essays on Golf-Course Architecture*, London, Country Life and George Newnes, 1920, p. 18: "On any course it will be a vital necessity to have a considerable range of teeing-grounds, so that each hole can be readily lengthened or shortened according to the state of the ground and the strength and direction of the wind"; notably, Colt and Alison are silent on the need for different teeing grounds for golfers of different ability or gender. On the importance of multiple tees on public golf courses, see *Municipal Golf: Construction and Administration*, New York, Playground and Recreational Association of America, [1927], pp. 10-11. For an early reference to forward tees on holes requiring long carries, see James Braid, *Advanced Golf*, London, Methuen and Co., 1908, p. 255. On the proliferation of tees and their purpose, see George C. Thomas, Jr., *Golf Architecture in America, Its Strategy and Construction*, Los Angeles, The Times-Mirror Press, 1927, p. 55-56: "It is becoming the custom to place two or even three tees on very long holes, or on holes with stiff carries, and does this not answer all arguments as to the length of carries? The back tee is for exhibition matches or scratch tournaments, and for the very low handicap men, and provides a chance to practices for difficult tests of play in tournaments; the middle tee is for general play and handicap competitions; the short tee for beginners or players whose game necessitates its use" (noting that Thomas also goes on to describe the value of multiple tees for various wind conditions). See also Robert Hunter, *The Links*, New York, Charles Scribner's Sons, 1926, p. 144: "Building several tees for most of the holes is the most economical way yet found to give variety to the play, and the only way available often to make certain holes attractive and testing for all classes of players;" see also Hunter's commentary (p. 146) on the challenges of getting certain golfers to play from forward tees: "There is a decided repugnance on the part of many poor players in America against using forward tees, and for this reason, more perhaps than for any other, we have had difficulty in bringing some promising courses up to championship standards. Fortunately, this is not the attitude of those poorer players in this country and abroad who belong to clubs having the best courses, where almost invariably they play from the forward tees. I was recently much amused and not a little puzzled at the resentment shown by certain members of a new club with a fine course,

- g. Course Conditions – It was observed in this era that turf conditions, and specifically the relationship between firmness and grass and soil types, impacted bounce and roll.<sup>90</sup> At least one architect at the time – Canada’s legendary Stanley Thompson – stressed a connection between soil type and course lengths, noting that “More length will be necessary on clay soils than on sand or loam ones.”<sup>91</sup> Chicago-based architect William Langford noted that driving distances for a single player could vary between 180 to 300 yards depending on the soil and weather conditions of an inland course.<sup>92</sup>

The dramatic increase in the number of golfers between 1900 and 1930 drove substantive investment in the game and led to specialization in several sectors of the golf industry, including golf course architecture and construction. These specialists, in large part responding to increases in hitting distances, created increasingly longer and more sophisticated golf courses.<sup>93</sup> It is seen in contemporary

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because there was one carry called for which not one in fifty of the members could hope to make with the best in his bag. A forward tee had been placed at this hole, but no persuasion could induce the poorer players to use it. It was dubbed “the ladies’ tee,” and they used it with satisfaction; but the virile gentlemen clung to the long tee from which the invariably drove their balls into the accursed hazard. It is difficult to know what to do with stupidity of that sort.”

<sup>90</sup> The spread of the game through Britain and beyond starting in the 1890s and accelerating in the early 1900s meant that golf courses were being constructed in environments and on soils quite different from the linksland that characterized the early history of the game. An exploration of these various environments and soil types is provided in Horace G. Hutchinson, *Golf Greens and Green-Keeping*, London, Country Life, 1906; this volume includes essays for golf courses built on links, heath land, pine forests, inland sites with medium soil, inland sites with heavy soil, parkland, and chalk downs. Each of these essays explores the implications of site and soil on turf quality and firmness and many offer comments on the impact on hitting distances and course design.

<sup>91</sup> Stanley Thompson, *About Golf Courses: Their Construction and Up-Keep*, Toronto, Stanley Thompson and Co., [ca. 1933], p. 10. See also S.V. Hotchkin, “Principles of Golf Architecture: Orientation and Playing Length of the Holes,” in Fred Hawtree, editor, *Aspects of Golf Course Architecture II, 1925-1971*, Worcestershire, England, Grant Books, 2008, pp. 34-35: “...the nature of the soil has to be carefully considered, before starting the work, for whether the soil is heavy or light...will materially affect the design of the course and the construction work that has to be done. The length of the course will to a great extent be affected by these matters...on lighter soils, where there is a considerable run of the ball at all times of the year, additional length can be added.” Note that Hotchkin contradicts Thompson on the need for additional length on sandy soils.

<sup>92</sup> William Langford, *Golf Course Architecture in the Chicago District*, Chicago, privately published, 1915, p. 1. See also H.S. Colt, “Golf Architecture” in Martin H.F. Sutton, *The Book of the Links, A Symposium on Golf*, London, W.H. Smith and Son, 1912, p. 74: “The distance of the tee shot will also vary enormously in summer and winter. There were several cases of drives of about 350 yards during the summer of 1911 with the new heavy rubber-cored balls, which in summer now alter so largely the length of the course”; of interest, Colt also notes that “the run of the ball will increase with the age of the links, as the surface of the ground becomes firmer with play.”

<sup>93</sup> A good summary of the evolution of golf course architecture and the increasing sophistication of design philosophy was provided by Sir Guy Campbell in his essay on “Links and Courses” in Bernard Darwin et al., *A History of Golf in Britain*, London, Cassell and Company, 1952, esp. pp. 109-112. In addition to the level of sophistication in the new golf course designs, contemporary architects also noted and stressed the additional costs associated the construction of new courses. See, for example, S.V. Hotchkin, “Principles of Architectural Construction on Commons and Downland” in Fred Hawtree, editor, *Aspects of Golf Course Architecture II, 1925-1971*, Worcestershire, England, Grant Books, 2008, p. 32: “Before the rubber-cored ball came into use, the costs of construction and maintenance were considerably less than at present. This of course is due to the larger area of ground now required, the additional length of the courses and the extra labour necessary for upkeep.”

sources that such efforts to lengthen or modify golf courses were not singular events, but ongoing occurrences.

An important observation to help explain the recurrence of lengthening was made by the influential British golf writer, historian and critic Bernard Darwin, who in 1912 wrote an essay on the relationship between the nature of a golf course and its influence on a golfer's approach to playing the game. Specifically, Darwin argued that "the long course produces the long driver." He went on to explain:

"It may be laid down that length of course makes for length of hitting. Nearly every golfer must at some time or other have experienced the sensation of visiting a big seaside course after playing for some while upon a small inland one. He will remember how the big carries and the long holes have pulled him out, till he has found himself hitting farther, not because he is noticeably hitting more cleanly, but just because he has the incentive. This was, to be sure, a much more familiar experience in the days of the gutty ball."<sup>94</sup>

At its essence, Darwin's essay argued that longer courses foster longer drives; and, in turn, that longer drives foster longer courses. It is a clear statement that hitting distances and course lengths are interrelated and that the relationship is cyclical.

## Circa 1930 to Circa 1980

### Hitting Distances Circa 1930 to Circa 1980

Hitting distance increases from the early 1930s to circa 1980 were more modest than the reported increases from circa 1900 to circa 1930. Roughly the first third of this era is associated with the Great Depression and World War II, during which years

The following table presents the ranges of reported hitting distances for key golfer cohorts over this time period.

*Table 3 Ranges of reported hitting distances circa 1930 to 1980*

Date	Recreational Women	Recreational Men	Elite Women		Elite Men	
			Typical Drives	Long Drives	Typical Drives	Long Drives
<b>Circa 1930</b>	100-150 yards	130-180 yards	175-225 yards	225-250 yards	220-260 yards	270-290 yards
<b>Circa 1980</b>	110-150 yards	160-200 yards	200-240 yards	250-270 yards	240-280 yards	280-300 yards

<sup>94</sup> Bernard Darwin, "The Influence of Courses Upon Player's Style" in Martin H.F. Sutton, *The Book of the Links, A Symposium on Golf*, London, W.H. Smith and Son, 1912, pp. 88-98

Within the cohort of elite male golfers, professionals as a group were incrementally longer than elite amateurs in the 1930s and 1970s (but generally level in the 1940s, 1950s and 1960s). With the cohort of elite women, professionals as a group were incrementally longer than elite amateurs from the 1940s through the 1970s.

### Key Contributors to Distance Circa 1930 to Circa 1980

Following more than three decades of rapid advances in the materials, design and manufacture of golf equipment, the onset of the Great Depression and the outbreak of World War II all but stopped investment in further R&D efforts. Moreover, additional efforts to contain distance increases were pursued during these same years, including the USGA's adoption on January 1, 1942 of an initial velocity restriction on golf balls of 250 feet per second (plus a 2 percent test tolerance).<sup>95</sup> Such factors contributed to limited advancement in club and ball technology and performance from the late 1930s through the 1960s.<sup>96</sup>

However, new technologies and materials, together with innovations in manufacturing and production, that emerged during the so-called "Space Race" of the 1960s migrated to golf in the 1970s. Some new R&D efforts led to the emergence of nascent technology that would eventually (in the 1990s and 2000s) have a significant impact on hitting distances.

The increases in hitting distances noted above were concurrent with developments in equipment, agronomics and swing technique that had the potential to generate incremental gains:

- a) Golf balls
  - 1) Improvements in cover painting and polishing to improve aerodynamic performance in the late 1930s.
  - 2) Improvements in cover vulcanization – vulcanization to improve cover durability was introduced in the 1920s but tended to loosen the tension of the rubber thread windings in the core and so compromised distance; in 1936, a new method for vulcanization was introduced that retained core tension.
  - 3) Incremental improvements in ball compression in the 1930s and 1940s that resulted from smaller centers, advancements in thread strength and resilience, improvements to the Great Circle winding pattern used for constructing cores, and methods for injecting liquid into the centre to restore internal pressure that was lost when the cover was

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<sup>95</sup> The initial velocity test was performed with a machine created by the Armour Research Foundation in Chicago; the test was used for roughly a year before wartime rationing of rubber terminated the production of new golf balls early in 1943. On the new test, see "USGA Rules to 1942 to Limit Distance Qualities of the Ball," *New York Times*, June 2, 1941, p. 24.

<sup>96</sup> This observation is consistent with a perspective voiced by notable players and historians. For example, Jack Nicklaus offered his perspective that "Once we got into a wound golf ball and once we got into steel shafts, the game from basically the early 1930s until the 1980's (with metal clubheads) and 1990's (with dramatic ball changes) changed very little"; see Jack Nicklaus with Jaime Diaz, "I've Been Thinking," *Golf Digest*, New York, March 2007, pp. 120, 123. See also Chapter 8 of John Stuart Martin, *The Curious History of the Golf Ball: Mankind's Most Fascinating Sphere*, New York, 1968, pp. 123ff., the central thesis of which is that golf ball design and production advanced minimally from the mid-1930s until the late 1960s.

molded and vulcanized. In the 1960s and 1970s, advances in chemistry and materials science led to the development of new synthetic compounds and polymers, both in wound and solid-core balls, that improved the resilience properties of the core, as well as the bonding between cover and core.<sup>97</sup>

- 4) Continued experimentation in dimple design (diameter, depth and angle of walls) and placement, and most importantly, the evolution of dimple patterns beginning in early 1970s. There was little variation in dimple patterns on golf balls over the preceding decades (1930s to early 1970s), principally and significantly because most ball manufacturers used molds that were designed and produced by one manufacturer with one standard pattern – the so-called “Atti pattern” that featured 336 dimples that covered 66 percent of the surface; the pattern had been developed by Raphael Atti, a New Jersey engineer and the molds were produced by the Atti Engineering Company in Union City, New Jersey. In the 1970s, golf ball manufacturers began to experiment with the size and depth of dimples, covering more of the ball’s surface with that dimples that were spaced closer together and arranged in different patterns. Engineers and designers working for the major ball producers found that they were able to control and begin to tailor the trajectory, spin rate, and angle of descent – properties that would impact overall distance for various types of players.<sup>98</sup>
  - 5) Surlyn covers in the late 1960s, which significantly improved the durability of the ball; players using the new Surlyn ball often reported longer distances when using more lofted irons due to lower spin rates.<sup>99</sup>
  - 6) Evolving golf ball regulations – In 1974, The R&A adopted for competition the larger (1.68” diameter) golf ball that had been standard in the United States since the 1930s (the larger ball would eventually become mandatory for all play under R&A rules in 1990). Two years later, in 1976, the USGA and The R&A adopted the Overall Distance Standard, which stated that a conforming ball could not travel (including carry and roll) more than 280 yards (with an 8% test tolerance). As explained at the time, the implementation of the ODS in 1976 was not a reaction to recent developments, but rather in anticipation of future (but unidentified) developments that could accelerate future distance increases.<sup>100</sup>
- b) Driver – Evolution toward clubheads with deeper faces and more mass (beginning in the 1940s); and continued refinement in the shape of the clubhead to place more mass behind the center of the clubface (1950s and 1960s). Beginning in 1979, the metal-headed wood was re-introduced to the game (following earlier experiments between the 1890s and

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<sup>97</sup> On the applications of chemistry and materials science, see especially C.W. Giffin, “What They’re Doing to the Ball and Why,” *Golf Magazine*, New York, March 1973, pp. 48-49, 84.

<sup>98</sup> On dimple patterns in the 1960s and 1970s, see C.W. Griffin, “What They’re Doing to the Ball – And Why,” *Golf Magazine*, New York, March 1973, pp. 49-50; C.W. Griffin, “New Dimples and Fewer ‘Smiles,’” *Golf Magazine*, New York, March 1976, p. 37; N.R. Kleinfeld, “In Pursuit of the Perfect Golf Ball,” *New York Times*, February 16, 1986, Section 3, p. 1ff.; and Kevin McGimpsey, *The Story of the Golf Ball*, Philip Wilson Publishers, London, 2003, p. 195.

<sup>99</sup> See Nick Seitz “Surlyn: New Ball Covering Promises More Durability, Equal Distance,” *Golf Digest*, Trumbull, Conn., April 1971, p. 63.

<sup>100</sup> See Arthur W. Rice, Jr., “Overall Distance Standard,” *Golf Journal*, Far Hills, N.J., April 1976, p. 34; and C.W. Griffin, “The Maximum Test,” *Golf Magazine*, New York, February 1977, p. 47.

1920s), this time with a hollow clubhead. The new metal woods had a rigid face (which alone did not increase hitting distances), but a larger sweet spot and higher moment of inertia that reduced distance loss from off-center hits.<sup>101</sup>

- c) Irons – Beginning in the 1930s, considerable experimentation shaping and distributing mass on the back of the clubhead to generate higher ball flight while reducing spin; later, in the 1960s, the introduction of investment casting that accelerated development of the “cavity-back” iron with perimeter weighting or heel-toe weighting<sup>102</sup>
- d) Club shafts – Invented and patented twenty years earlier, the steel shaft was at last widely adopted in the early 1930s following approval for play by the USGA (1924) and The R&A (1929).<sup>103</sup> With less torsion than a hickory shaft, steel allowed players to swing harder at the ball.<sup>104</sup> Throughout the 1930s, improvements in the production and design of steel shafts followed, including refinements to the tapering and stepping-down of shaft diameter that could impact launch angle and spin rate.<sup>105</sup> Experimentation with alternative shaft materials began anew in the 1960s, including lightweight aluminum and fiberglass shafts that were reported to benefit some players with slower swing speeds but ultimately were short-lived experiments. In the late 1960s, engineers working for Union Carbide, which had been using graphite in aerospace applications, approached golf club shaft manufacturers as they were looking for additional applications for their advanced technologies. Stronger than steel, graphite shafts could be made lighter than steel shafts, allowing additional weight to remain in, or be transferred to, the clubhead; in addition, graphite shafts could be made longer,

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<sup>101</sup> Hollow metal woods enabled engineers to redistribute weight from the center of the clubhead to the shell of the clubhead. Despite a comparative reduction in clubhead volume, the new metal drivers increased MOI by about 9%. On the advent of metal woods ca. 1980, see Jerry Tarde, “Can Metal Woods Help Your Game?” *Golf Digest*, Trumbull, Conn., December 1981, pp. 57-59; and Jerry Tarde, “Metal Woods: The Game’s Hottest Ticket,” *Golf Digest*, Trumbull, Conn., December 1982, pp. 66 - 70, 73.

<sup>102</sup> Several manufacturers promoted these new designs as “game improvement irons” for higher handicap players, claiming increased ball control from larger “sweet spots,” higher ball flight and greater distance.

<sup>103</sup> The steel shaft was first patented by Arthur F. Knight in 1910; the patent was subsequently purchased in 1920 by the Horton Manufacturing company, who were the first to put it into production.

<sup>104</sup> Steel shafts typically had between 2 and 5 degrees of torsion, while hickory shafts could twist as much as 20 degrees. One perspective on the impact of steel shafts on hitting distances was offered by Bob Jones who claimed that “the main difference in the play of steel and hickory is that the boys nowadays can hit more nearly all out – more nearly full power – without running the risk of something going wrong. I think that the golf ball itself hasn’t got that much additional power, but people my own age...[are] driving the ball a good deal farther today than when they were younger”; see Harry Paxton and Fred Russell, “A Visit with Bobby Jones,” *Saturday Evening Post*, Indianapolis, April 5, 1958, p. 68. For additional commentary on the ways in which steel shafts altered swing techniques and encouraged a harder swing, see Henry Cotton’s essays on “Styles and Methods” in Bernard Darwin et al., *A History of Golf in Britain*, London, Cassell and Company, 1952, pp. 126-128.

<sup>105</sup> On the relationship between shaft design, shaft flex, launch angle and spin rate, see Ralph Maltby, *Golf Club Design, Fitting, Alteration and Repair: the principles and procedures*, Newark, Ohio, Faultless Sports, 1974, pp. 207-217; and Ralph Maltby, *The Complete Book of Golf Club Fitting and Performance: The Principles, Procedures and Playability Factors*, Newark, Ohio, The GolfWorks, 2011, pp. 307-324.



allowing for increased clubhead speed.<sup>106</sup> Some early adopters of graphite shafts claimed significant increases in hitting distances, especially with iron clubs on approach shots.<sup>107</sup>

- e) Mowing heights – Gang mowers, typically with five to seven blades per reel, were commonly used from the 1930s to the 1970s to mow fairways. The ground-driven reels used from the 1930s through the 1950s enabled mowing heights between 0.75"-1.5"; in the late 1960s, triplex mowers were introduced with reels that were driven hydraulically, enabling lower mowing heights between 0.5"-0.75".<sup>108</sup>
- f) Agronomic conditions – The first pop-up sprinklers were invented in the 1920s, but widespread adoption of the large-scale irrigation systems which could be deployed on the surface or buried in the ground did not become common until the 1930s.<sup>109</sup> As with equipment, R&D initially was curtailed due to the Depression and World War II; but in the post-war decades, the development of new strains of creeping bentgrass and bermudagrass, the continued improvement to fairway irrigation systems (e.g., automatic irrigation systems with double-and triple-row irrigation heads that provided greater fairway coverage, as well as more precise irrigation) and practices (e.g., the ability to measure soil moisture levels), new types of mechanical equipment for golf course maintenance practices (including improvements in aeration devices, thatch removal machines and multi-purpose machines), and new formulations for weed killers and insecticides led to improved agronomic conditions that on some golf courses could have resulted in increased hitting distances.<sup>110</sup>
- g) Swing technique – Key advancements in equipment – notably steel shafts (whose lower torsion allowed skilled players to swing harder), refined dimple patterns (which created more lift), and deeper faces on drivers – accelerated the adoption of a more upright swing that produced significantly higher ball flight trajectories that for some players may have generated more distance.<sup>111</sup> A significant step forward in golf instruction came in the late

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<sup>106</sup> In addition, early graphite shaft manufacturers asserted that graphite shafts minimized distance loss for off-center hits; see, for example, Bill Winquist, "The Graphite Shaft: Black Magic or Fad," *Golf Magazine*, New York, July 1973, pp. 46, 102.

<sup>107</sup> See, for example, Sandra Haynie, 1974 U.S. Women's Open champion, who first used graphite shafts in 1975: "Since I hit the ball so much farther, I find myself playing a different game than I ever have before. Now I am two or three clubs shorter on my approach shots and I know if I don't hit my driver perfectly, it will still be in play"; as quoted in "A Vote for Graphite," *Golf Magazine*, New York, August 1975, p. 63.

<sup>108</sup> SU02 – The Evolution of Fairway Agronomy, pp. 1-2

<sup>109</sup> SU02 – The Evolution of Fairway Agronomy, p. 5. Important innovations during this era included gear-driven sprinkler heads, pop-up sprinkler heads, slow-rotating sprinkler heads, quick coupler valves, traveling sprinklers, and automatic-sequencing hydraulic controllers with electric timers. On the history of golf course irrigation, see Kent W. Kurtz, "The History of Golf Course Irrigation," *Hole Notes: The Official Publication of the MGCSA*, May 2003, pp. 11, 15. It is believed that Brook Hollow Golf Club in Dallas, Texas, became in 1920 the first golf course with a full in-ground irrigation system; see Bradley S. Klein, "Techno Hype: Truth is in the Turf," *Golfweek*, Orlando, Fla., June 20, 1998, p. 33.

<sup>110</sup> T.T. Taylor, "Turfgrass – Its Development and Progress," *USGA Journal and Turf Management*, New York, September 1957, p. 32; and SU02 – The Evolution of Fairway Agronomy, pp. 5-6.

<sup>111</sup> The evolution to the upright swing can be illustrated, for example, by examining the swings of three legendary champions: Robert Tyre ("Bobby") Jones, Jr. (who learned and played the game exclusively in the wooden-shaft era), Ben Hogan (who first learned to play with wooden shafts but played with steel shafts throughout his competitive career as a professional); and Jack Nicklaus (who learned to play with a steel shaft). See Robert Tyre

1960s, with the first rigorous scientific analysis of the golf swing and the various factors that contribute to hitting distances.<sup>112</sup> These contributors to improved swing technique, along with other ways in which players improved their performance, could have contributed to increased distance.

### The Evolution of Golf Course Lengths Circa 1930 to Circa 1980

The onset of the Great Depression and World War II brought golf course construction virtually to a halt from 1930 through the late 1940s in many countries where the game was well-established, with the notable exception of the United States, where federal public works programs led to the construction of more than 350 public golf courses over this period.<sup>113</sup> When course construction resumed in the United States in post-war years,<sup>114</sup> demand to toughen and lengthen golf courses in response to incremental increases in hitting distances and low scoring led to incremental growth in the median length of golf courses in the United States.

By the end of the 1970s, the length of a typical golf course was around 6400 yards (noting that golf courses in the United States were marginally longer); and the longest golf courses were typically around 6900 yards.<sup>115</sup> The increased emphasis on forward tees in the 1960s and 1970s helped reduce typical

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Jones, Jr., *Bobby Jones on Golf*, New York, New Metropolitan Fiction, 1930; Robert Tyre Jones, Jr., *Bobby Jones on the Basic Golf Swing*, Garden City, N.Y., Doubleday, 1969; Ben Hogan, *Power Golf*, New York, A.S. Barnes, 1948; Ben Hogan, *Five Lessons: The Modern Fundamentals of Golf*, New York, A.S. Barnes, 1957; Jack Nicklaus with Ken Bowden, *Golf My Way*, New York, Simon and Schuster, 1974; and Jack Nicklaus with Ken Bowden, *The Full Swing*, New York, Simon and Schuster, 1984.

<sup>112</sup> Alastair Cochran and John Stobbs, *The Search for the Perfect Swing*, Philadelphia and New York, J.B. Lippincott Company, 1968

<sup>113</sup> Geoffrey S. Cornish and Ronald E. Whitten, *The Architects of Golf: A Survey of Golf Course Design from Its Beginnings to the Present, with an Encyclopedic Listing of Golf Course Architects and Their Courses*, New York, HarperCollins, 1992, pp. 99-100, 105-109. However, there was significant construction of new courses in the late 1930s by the Roosevelt administration – in particular, the Works Progress Administration (WPA) and Civilian Conservation Corp (CCC), which together built more than 350 public golf courses across the country.

<sup>114</sup> Many golf courses in the UK fell into disrepair during World War II, either from disuse or from war damage. There was surge in reconstruction of courses in the years following the cessation of hostilities; on the unique considerations and challenges of this era, see J. Hamilton Stutt, “The Post-War Golf Course” in Fred Hawtree, editor, *Aspects of Golf Course Architecture II, 1925-1971*, Worcestershire, England, Grant Books, 2008, pp. 158-161 [the original article ran in *Golf Monthly*, London, May 1945].

<sup>115</sup> The data collected for H-09 Analysis of the Evolution of Golf Course Lengths are notably consistent with the recommendations on course lengths provided in contemporary publications on golf course design principles; see, for example, H. Burton Musser, *Turf Management*, New York, McGraw Hill, 1950, p. 260 (“A good short course should be approximately 6,200 yd. in length. A good average course should be approximately 6,400 to 6,500 yd. in length and one of long championship caliber, 6,700 to 6,900 yd. or higher”); Ray Holland, ed., *Planning and Building the Golf Course*, Chicago, National Golf Foundation, 1967 and 1970, p. 6 (“over 3,000 yards, preferably around 3,200 yards for 9 holes”; this source (p. 9) also quotes a recommendation from the American Society of Golf Course Architects of 6200-6500 yards); Fred Hawtree, *Elements of Golf Course Layout and Design*, London, Golf Development Council, [1968], p. 2 (“a good standard is about 6,350 yards”; and “so-called championship length is from 6,700 to 7,000 yards”); and Gervase Carre Riddell, *Golf Architecture in Australia: Its Design and Construction*, [Australia], self-published, 1974, p. 7, who suggested there should be variation in length based on purpose and audience – about 6000 yards for a “holiday” or municipal course and about 7000 yards for a

playing lengths for shorter hitters from around 6100 yards around 1930 to about 5700 yards in the 1970s (H09 – Analysis of the Evolution of Golf Course Lengths).

An analysis of historical source materials suggests that the following developments influenced golf course lengths over this time period:

- a. Hitting Distances – Growth of the golf economy, coupled with the large increases in hitting distances in the early decades of the 20th century, led to many course renovation and replacement projects in the 1910s and especially 1920s, a trend that was abruptly halted with the onset of the Great Depression and subsequent outbreak of World War II. This included many capital projects that were in the planning phases that were suspended. When course construction resumed in the post-War era (again driven by a surging economy), many of these projects addressed latent desires for lengthening that had developed in the pre-War II years, as well as perceived incremental increases to hitting distances associated with the 1930s and 1940s (and in particular the adoption of the steel shaft).<sup>116</sup>

The evolution of hole length and its relationship to hitting distances that was observed in previous eras continued to hold import in architectural theory in this time period, as did the now familiar principles that an ideal golf course should provide a test for every club in the bag.<sup>117</sup> As a consequence, increases in hitting distances continued to lead to increases in the recommended lengths for individual holes.<sup>118</sup>

- b. Low Scoring – Concerns about low scoring at the elite level confirmed beliefs that the relative length of golf courses had been diminished by increased hitting distances. Importantly, in the 1937 U.S. Open at Cherry Hills in Colorado, American professional Ralph Guldahl returned a record score of 71-69-72-69—281 (-7), at a time when any score under 70 was seen as a significant challenge to the integrity and status of a golf course. Soon thereafter, the USGA commissioned golf architect Robert Trent Jones to study driving distance at the U.S. Open, with an eye to developing a strategy to combat the low scores that resulted in part from increased hitting distances.<sup>119</sup> The outbreak of World War II

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championship course. Continued course lengthening was a frequent theme of contemporary critics, most of whom wrote strongly about the negative impact of increased course lengths on the game; see, for example, Gene Sarazen, “Design for Disaster,” *Golf Magazine*, New York, May 1967, pp 54-105 (the sub-title of the articles provides an appropriate summary of Sarazen’s perspective: “By constructing courses of back-breaking length, architects are slowly but surely ruining the game for its No. 1 patron – the duffer.”)

<sup>116</sup> Geoffrey S. Cornish and Ronald E Whitten, *The Architects of Golf: A Survey of Golf Course Design from Its Beginnings to the Present, with an Encyclopedic Listing of Golf Course Architects and Their Courses*, New York, HarperCollins, 1992, p. 111. See also the commentary offered by Sir Guy Campbell in Bernard Darwin et al, *A History of Golf in Britain*, London, Cassell and Company, 1952, p. 111: “And since, during all this time, the power of the ball and, from the ‘30s onward, that of steel shafts also, increased, the periodic ‘stretching’ and remodeling of links and courses thereby imposed, proved waste of labour and money, and the aim and intention of designers were frustrated.”

<sup>117</sup> See, for example, Theodore Moone, *Golf from a New Angle: Being Letters from a Scratch Golfers to His Son at College*, London, Herbert Jenkins, 2nd edition, 1934, p. 167

<sup>118</sup> See, for example, Chapter 11 “Elements of Golf Course Design,” in H. Burton Musser, *Turf Management*, New York, McGraw Hill, 1950, pp. 252-273.

<sup>119</sup> Jones first measured driving distance at the 1940 U.S. Open at Canterbury Golf Club near Cleveland; and after the war resumed testing in 1949. The results of these initial tests were published in Robert Trent Jones, “How the

prevented quick action, but in 1950 Jones was hired to strengthen the South Course at Oakland Hills outside Detroit in preparation for the 1951 U.S. Open. These renovations included added length, added bunkers, narrowed fairways, reduced par on two holes and overseeding to create thick and penal rough; in sum, Jones created the new template for the U.S. Open that in turn influenced design and setup for other golf courses and competitions at various levels of the game.<sup>120</sup>

Jones' new style of golf course, which he labelled "modern golf architecture," incorporated large features – oversized bunkers, long and straight fairways, greens that were twice the size of typical greens of the period, and huge, long, serpentine tees that on some courses stretched as long as 80 yards. This new approach to golf course design was first realized in 1948 at Peachtree, a course in Atlanta that Jones co-created with Robert Tyre "Bobby" Jones, Jr., that could be stretched to more than 7400 yards.<sup>121</sup> Jones' work established a new precedent for long and challenging golf courses that significantly influenced trends in golf course design, as well as consumer expectations and preferences, over the next three decades and around the world.<sup>122</sup>

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Modern Ball Plays," *USGA Golf Journal*, New York, August 1949, pp. 15-17. In 1940, in the second round on the fifth hole, the field averaged 253.4 yards; in 1949, in the first round on the tenth hole, the field averaged 260.2 yards.

<sup>120</sup> Robert Trent Jones, Sr. was also hired to renovate Baltusrol (1952), Olympic (1954), Oak Hill (1956), Southern Hills (1957), and Winged Foot (1958) in preparation for U. S. Opens. On Jones' philosophy of design, and in particular for his perspectives on his work to lengthen and toughen U.S. Open venues, see Robert Trent Jones and Larry Dennis, *Golf's Magnificent Challenge*, New York, McGraw-Hill, 1988.

<sup>121</sup> Geoffrey S. Cornish and Ronald E Whitten, *The Architects of Golf: A Survey of Golf Course Design from Its Beginnings to the Present, with an Encyclopedic Listing of Golf Course Architects and Their Courses*, New York, HarperCollins, 1992, pp. 113-114. Herbert Warren Wind noted that Peachtree had been designed for length, in order to challenge the game's elite, but still questioned if it would stand the test of time and, importantly, further increases in distance: "Seventy-four hundred yards is a lot of golf course. The average length for each hole, counting the par-3s, would be over 410 yards. And the question is simply this: Is this the end or will Peachtree be merely a continuation of the race in which the golf course tries to keep up with advances – technical and otherwise? In other words, will Peachtree become outmoded in the years ahead and a 7,600-yard course be necessary to test the ability of a topnotch golfer?"; in Herbert Warren Wind, "What's Right and Wrong with Modern Course Design," *Golf Digest*, Trumbull, Conn., November 1975, p 49. See also Herbert Warren Wind, "Linksland and Meadowland," *The New Yorker*, New York, August 4, 1951, in which the author noted that Jones "deplores the fact that in the last twenty years par has lost its significance."

<sup>122</sup> On the global influence of Robert Trent Jones, Sr., see Geoffrey S. Cornish and Ronald E Whitten, *The Architects of Golf: A Survey of Golf Course Design from Its Beginnings to the Present, with an Encyclopedic Listing of Golf Course Architects and Their Courses*, New York, HarperCollins, 1992, p. 131: "The dominant influence on British and European golf course architecture in this period was American course design...[many] attributed it to the worldwide fame of Robert Trent Jones...the influence was real, and by the early 1970s the transition was complete. Such far-flung courses as Woburn in Britain, Tobago in the Caribbean, and Mount Mitchell in North Carolina featured broad, sweeping fairways, large, undulating greens, long tees, yawning bunkers with glistening white sand and finely manicured playing areas." On consumer preferences to see long and challenging courses for elite championships, see "Readers Favor Tougher Golf Courses," *Golf Digest*, Trumbull, Conn., March 1975, pp. 16-17. Naturally, there were dissenting voices who railed against the trend toward lengthening; one particularly vocal critic of Jones and the trend toward longer courses was PGA Tour professional Dave Hill – see his chapter on "Golf Course Architecture" in Dave Hill and Nick Seitz, *Teed Off*, Englewood Cliffs, N.J., Prentice-Hall, 1977, pp. 104-121, and especially pp. 112-113, where he argues that no course should be longer than 7000 yards, instead suggesting an ideal length of 6500 yards for recreational play and 6900 yards for touring professionals.

The emphasis on defending the golf course against low scoring was not unique to Jones, although it might well be true that Jones' philosophy influenced the thinking of his peers. It does seem to be the case, nonetheless, that concern about low scoring was elevated more broadly at this time. Tom Simpson, a Cambridge-educated lawyer turned golf course architect, authored an entry on golf course architecture for a collection of essays of golf course design, construction and maintenance, first in 1933, which he then revised for a second edition of the book in 1950. Where the 1933 essay is silent on the issue of low scores, by 1950 it had become a central theme of his concern about the state of the game and golf courses.<sup>123</sup>

- c. Multiple Tees – In the same spirit as Robert Trent Jones, Sr. who stretched single tees to great lengths to achieve golf courses that could be played at many lengths, including well over 7,000 yards, many golf course architects favored a multiplication of teeing areas both to provide variable length and substantial length to their designs. Ultimately, this multiplication of tees led many courses to shorten forward tees and significantly lengthen the longest tees.<sup>124</sup>

The leading advocate for the proper positioning, design and length of forward tees was Alice Dye, an accomplished female amateur golfer and the wife of golf course architect Pete Dye. Many of the courses created by Pete and Alice included forward tees of less than 5,000 yards (distances that had not been common since the 1890s). Importantly, these tees were not afterthoughts, but were carefully considered and essential elements that informed the design of each hole. Alice Dye's advocacy for proper length had influence globally on the shortening of forward tee lengths.<sup>125</sup>

- d. Golf Course Developments – Beginning in the 1960s, and particularly in the United States, the integration of golf courses with planned housing developments in some projects may

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<sup>123</sup> See Tom Simpson, "The Design and Construction of a Golf Course" in Martin H.F. Sutton, *Golf Courses, Design, Construction and Upkeep*, 1st edition, London, Simpkin Marshall, 1933, pp. 1-9; and Tom Simpson, "The Design and Construction of a Golf Course" in Martin H.F. Sutton, *Golf Courses, Design, Construction and Upkeep*, 2nd edition, London, Simpkin Marshall, 1950, pp. 10-24, esp. p. 18: "Whatever people may think of the merits of graded clubs and the modern ball that goes farther and farther, few students of the game will deny that the inventor has been allowed too much license. The combined effect of these modern inventions has proved the inadequacy of existing courses; their defence being unequal to the attack of the powerful players, as evidenced by the number of scores under 70 returned." In the 1933 essay, Simpson (p. 3) had asserted that the course should measure between 6,000-6,350 yards and suggested that "The demand for very long courses is merely a passing phase"; in the 1950 essay (p.18), he stated "It is hoped that the demand for very long courses is merely a passing phase." Further, it is noted that Simpson was the co-author of a book that took on this same theme in 1929 in a chapter titled "Attack and Defence"; see H.N. Wethered and T. Simpson, *The Architectural Side of Golf*, London, Longmans, Green, 1929, p. 14: "Under no circumstances can a course of reputation permit of scores in the neighborhood of the sixties without incurring serious opposition...What, then, is the nature of this "attack," as it may be termed, that needs a frequent readjustment of defence?...The first – that one that is considered the most serious of all – is the alarming increase in distance obtained by the modern ball."

<sup>124</sup> See, for example, Fred Hawtree, *Elements of Golf Course Layout and Design*, London, Golf Development Council, [1968], p. 4, which distinguishes between the "extreme backs" and the "forward areas suitable for everyday use."

<sup>125</sup> Alice Dye and Mark Shaw, *From Birdies to Bunkers, Discover how Golf Can Bring Love, Humor and Success into Your Life*, New York, HarperCollins, 2004; and Alice Dye, "Are today's courses too long?," *Golf Course Management*, July 1985, pp. 66, 70, 74-75

have led to incremental course lengthening that provided for more golf course frontage and thereby increased the total market value of the development. However, just one contemporary source speaks in passing to this idea and this study was not able to locate any definitive examples.<sup>126</sup>

## Summary

This extensive review of primary and secondary sources demonstrates that hitting distances for all cohorts of golfers increased significantly from the 1890s until 1980. At various times within this history, contributors to increased hitting distances included factors related to: 1) golf equipment; 2) the swing techniques employed by golfers; and 3) course conditions, comprising maintenance practices and agronomy. It is also clear that many of these factors worked collectively, rather than independently, to create these distance increases.

Further, it has been shown that many of the primary source materials attributed the contemporary increases in hitting distances primarily to innovations in golf balls and golf clubs. However, this study makes it clear that such attribution of hitting distance increases solely to golf equipment is incomplete. While it is likely that the introduction of the rubber-core golf ball ca. 1900 was the cause of the single most significant increase in hitting distance before 1980 (10-25 yards for the first generation Haskell ball), it is not possible to quantify discrete increase to any of the other contributing factors based on the historical records, nor is it possible to rank the significance of these other factors.

Concurrently, this review has illuminated the various factors that contributed to the lengthening of golf courses before 1980. Before 1900, the primary driver of course lengthening was the standardization of golf courses, comprising both standardization to 18 holes, as well as standardization in the distribution of one-, two-, and three-shot holes found on a typical golf course. After 1900, the primary driver of course lengthening was increased hitting distances, a point that is clearly underscored by contemporary source materials. While contemporary sources sometimes characterize course lengthening as a reaction to low scoring, a critical reading of these sources often uncovers the root cause of distance increases.

Finally, this review of historical materials demonstrates that the lengthening of golf courses often closely followed increases in hitting distances, and that there was a causal relationship between these two trends. Increased in hitting distances led to increases in course lengths in a cyclical relationship.

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<sup>126</sup> Herbert Warren Wind, "What's Right And Wrong with Modern Course Design," *Golf Digest*, Trumbull, Conn., November 1975, p. 52: "When a new course is built as part of a real estate development, as many have been, the promoter's main concern is not to create a superior course, but to sell house lots at good prices. The architect is frequently told, for example, to build only long straight holes in such a way as will provide the maximum number of course-front lots." The first and most comprehensive monograph on golf course developments was written by Rees L. Jones and Guy L. Rando, *Golf Course Development*, Washington, D.C., ULI – the Urban Land Institute, 1974.

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