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Article in Journal of Sports Sciences · January 2002
DOI: 10.1080/026404102202675684

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Charles Reep (1904–2002): pioneer of notational and performance analysis in football

Seldom can the birth of a new activity be pinpointed with any accuracy, but at 15.50 on 18 March 1950, a spectator at Swindon Town's home game against Bristol Rovers took a pencil and notebook out of his pocket. Wing Commander Charles Reep was at that moment beginning to create the first comprehensive notational analysis system for football. In the years that followed, he quickly saw how the information he was collecting could be used to plan strategy and analyse performance. He soon became the first professional performance analyst in football and later co-authored the first scientific paper to apply statistical analysis to football. Charles Reep died recently at the age of 97; the aim of this memorial paper is to review the existing published work both by and about this remarkable man, much of which is scattered in relatively obscure locations.

Thorold Charles Reep was born in Cornwall on 22 September 1904. Details of his early life are recorded by Lyons (1997) in a paper that gives an overview of his career. After training as an accountant, Reep joined the Royal Air Force (RAF) in 1928. The origins of his analytical interest in football can be traced to 1933 when he attended a talk given by Charles Jones, the captain of Herbert Chapman's Arsenal team. Reep was fascinated by the detailed description of the tactics that were being used to create goal-scoring opportunities for Arsenal's wingers, Joe Hulme and Cliff Bastin. In the years that followed, Reep himself described how he began to put these methods into practice with a series of teams in the RAF (Reep, 1989). This experience, together with the meticulous attention to detail he had learned as an accountant, was the ideal preparation to develop a notational system for recording every on-the-ball action in a football match. This system, which Reep had in place by the end of 1950, was to remain unchanged for over half a century, during which time he recorded nearly 2500 games, each analysis still carefully preserved. Only sketchy details of his notational system have ever been published (Reep, 1961), showing the game broken down into a series of passing movements, with each discrete action within each movement identified by a shorthand code.

In August 1951, Reep made contact with Stan Cullis, manager of Wolverhampton Wanderers; weekly performance analysis figures were subsequently produced as Wolves began to dominate English football in the 1950s. Cullis has acknowledged the importance he

attached to Reep's analyses (Cullis, 1961; Reep, 1989) and the close relationship between the two is evident in an unpublished letter written from Reep to Cullis, dated 6 December 1954, in which he outlines a strategy to defeat Honved, just a few days before Wolves' famous victory against the Hungarians. The distinctive style of play that evolved from Reep's performance analysis is described both by Reep (1982) and Cullis (1961). After retiring from the RAF in 1955, Reep spent 3 years as a full-time professional performance analyst for Sheffield Wednesday. Since there is no published record of any other comprehensive notational system being used to assess performance in any sport in the UK until the 1970s, Reep is clearly the first person to develop and apply a sports notational system in this country. His work in the 1950s pre-dates, by perhaps two decades, subsequent attempts to notate and analyse performance in football.

In 1962, Reep published two articles that showed how his notational system could be used to assess the performance of the England team and of League and Cup winners Tottenham Hotspur (Reep, 1962a,b). This was followed in 1965 by a series of newspaper articles in the *Daily Mail* in which the performances of individual players were compared quantitatively. It was at this time that Reep began to look more closely at the structure of the results he was observing and became interested in the role that random chance appeared to play. He made contact with Bernard Benjamin, later to become President of the Royal Statistical Society, and together they published the first paper on football to appear in a statistical journal (Reep and Benjamin, 1968). They showed that the number of completed passes in a passing movement could be modelled by the negative binomial distribution, and also established several near-constant ratios for various facets of the game. They pointed out that the demonstration of a stochastic element in football should come as no surprise to statisticians, but the implications were widely misinterpreted and ridiculed by the media, the sports editor of the *Times* leading the way (Hennessy, 1969). Subsequent papers were co-authored, extending the findings to goal-scoring in football as well as to events in other sports, suggesting that the role played by random chance in determining the outcome of events in sport was greater than generally supposed (Reep *et al.*, 1971; Pollard *et al.*, 1977).

In 1980, Reep approached Graham Taylor, then manager of Watford. Reep himself has published a copy of his initial letter to Taylor, as well as a detailed account of how their association developed, with Reep and a colleague, Simon Hartley, under contract to provide match-by-match performance analysis of the team (Reep, 1990a,b). It was during this time, in 1981, that Reep was contacted by Charles Hughes, soon to become Director of Coaching at the Football Association (FA). Reep briefed Hughes on his methods of performance analysis and the conclusions that he had reached. He also arranged for Hughes' assistant to be trained to use his system of notation. The extent to which Hughes made use of Reep's data and methods in his later much publicized book (Hughes, 1990) and in the content of subsequent FA coaching courses is the subject of much controversy. Although this received considerable attention at the time (Miller, 1983; Pitt and Nawrat, 1983; Lacey, 1984), the issue of Reep's influence on Hughes and the FA is best summarized by Larsen (2001), who explores the evidence in detail.

According to Larsen (2001), performance analysis had been used in Norway since the 1970s by Egil Olsen, who, as manager of Norway, eventually made contact with Reep in 1993 and discovered much common ground. Reep was flown to Oslo by the Norwegian FA as the guest of honour at a match against England, a real irony considering that the English FA had, for over 40 years, rebuffed Reep's repeated offers to share the results of his work. Larsen (2001) has also provided a thorough assessment of Reep's influence on the development of football, both in England and in Norway. However, he exaggerates the number of teams and managers with whom Reep collaborated, as do Lyons (1997) and Goksoyr (1999). For example, he was never involved with Cambridge United, Sheffield United or Wimbledon, all of whom did indeed employ a performance analyst, Neil Lanham, but who worked independently of Reep (Lanham, 2002). All this is confirmed by Pitt (1992) in a much earlier article, which describes the controversy over playing styles that had, at that time, been largely provoked by Reep and Hughes.

Although Reep's primary focus was on the development of an effective playing style based on his performance figures, the information collected lends itself to other statistical analyses. Pollard *et al.* (1988) showed how different playing styles could be quantified and compared using principal component analysis. Pollard and Reep (1997) used logistic regression to investigate the probability of a shot resulting in a goal under different circumstances. The results were then used to devise a method of quantifying the effectiveness of specific strategies of play.

When describing his methods of performance analysis and his conclusions about tactics to a football manager for the first time, Reep always insisted on a presentation of at least five hours. Despite his somewhat dogmatic manner, anyone attending these sessions will remember the care and thoroughness of his preparation, as well as the warmth, enthusiasm and conviction with which he spoke. Unfortunately, his attempts at publication usually resulted in articles of enormous length and detail that were, unsurprisingly, rejected by editors. His cause was not helped by a refusal to compromise, but this was a trait that also served him well in the face of the hostile reaction he invariably provoked from the football community in England. As well as a pioneer in notational and performance analysis, especially in their practical applications, Reep should also be remembered for his single-mindedness in showing how careful measurement can produce deep insights into the way in which a continuous game such as football can be analysed.

Charles Reep died on 3 February 2002, a milestone characteristically ignored by the football establishment in England, despite a brief obituary in the *Times* (2002). All those engaged in notational and performance analysis throughout the world owe much to Charles Reep, and those who knew him will miss his insight into 'the beautiful game'.

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