Dr. R. Tait McKenzie: Pioneer and Legacy to Physiatry

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In history, a great volume is unrolled for our instruction, drawing the materials of future wisdom from the past errors and infirmities of mankind.

Edmund Burke

INTRODUCTION

Our purpose in this article is to illustrate scientist and physician R. Tait McKenzie's contributions to the scientific development of physical training and therapeutic exercise in restoring function and reducing disability. McKenzie's legacy to physical medicine and rehabilitation (PM&R) is his fundamental concept, much later articulated by the American College of Sports Medicine, to the importance of frequency, intensity, time, type, volume, and progression of therapeutic exercise [1,2]. His classic book instructs physicians for the first time to the scientific value of exercise in health and disease [3]. He categorized the specific pathologic conditions that can be effectively treated with exercise, and he emphasized the precision necessary in dosage and timing to achieve the benefit. In the preface to his first book, Exercise in Education and Medicine [3], he exposed the medical profession's one-dimensional approach to therapeutics, that is, an emphasis only on pharmacology, an approach that has prevailed until very recent times [4].

"*Perhaps a certain laziness which is inherent in both patient and physician tempts to the administration of a pill or draught to purge the system of what should be used in normal muscular activity, but there is a wide dearth of knowledge among the [medical] profession of the scope and application of exercise in pathologic conditions, and the necessity of care in the choice and accuracy of the dosage will be emphasized throughout the second part of this book* [3]."

As a scientist and clinician, McKenzie also recognized the lack of interest by the medical profession in the physiology of exercise and the importance of physical training for promoting good health and function.

McKenzie's use of physical therapy in the rehabilitation of the war wounded in Great Britain, Canada, and the United States during World War I (WWI) entitles him to recognition as one of the earliest pioneers of PM&R. His second textbook, Reclaiming the Maimed: A Handbook of Physical Therapy [5], was used by the military in all 3 countries to develop and establish physical therapy services in the reconstruction hospitals during WWI. His work influenced physiatrists Frank Granger, George Deaver [6], and John Stanley Coulter, 3 major leaders in the field in the decades after the war.

EARLY INFLUENCES: MCGILL, HARVARD, AND SPRINGFIELD

McKenzie experienced a "fascination [with] acrobatics and gymnastics" during his early undergraduate years at McGill University [7]. He competed in track and field, and set the intercollegiate high jump record in 1886 before entering medical school. During his medical school days, he developed his first interests in physical education and was inspired by Dudley A. Sargent, MD, who conducted a 6-week course at the Harvard Summer School [8]. McKenzie attended courses for 2 summers, in 1889 to 1890, on the theory of systems in physical education, anthropometry, applied anatomy, and other sciences, which were

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Disclosure: nothing to disclose

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Disclosure: nothing to disclose

Submitted for publication August 17, 2014; accepted September 5, 2014.

PM&R
1934-1482/14/$36.00
Printed in U.S.A.

Vol. 6, 866-875, October 2014
http://dx.doi.org/10.1016/j.pmrj.2014.09.006

applied in class drills that involved exercises with weights, vaulting with bars and horses, tumbling, and dancing. Sargent's systematic measurement of body proportions and research that involved thousands of male and female students and that included physiological studies of respiratory capacity and grip strength, established that training approaches must be scientifically based. This same scientific rigor is evident in McKenzie's future cardiac studies [9]. Many of the machines used in gymnasiums throughout the United States, such as rowing, pulley systems for specific muscle groups, and lifting, were developed by Sargent. However, Sargent faced opposition to his scientific approaches to the study of physical conditioning by the conservative elements of academe. Yet, McKenzie predicted that Sargent's place in the history of physical education would be as "pioneer, thinker, and scientist" [10].

It was during medical school at McGill University that McKenzie began to instruct students in gymnastics, under the direction of James Naismith, director of athletics [11]. McKenzie's interest in exercise physiology developed during his years at the university, as is reflected in his appointment as medical director of physical training after graduation from medical school. Naismith would subsequently join another of Sargent's students, Luther H. Gullick, MD, who was a pioneer in physical education and founded the first school at Springfield College. (Naismith and Gullick are credited with the invention of the game of basketball [12]). After graduation from medical school, McKenzie became a close friend of and collaborator with Gullick, and the two trained new directors of the YMCA in physical education. Gullick offered McKenzie a position at the YMCA in Springfield [13], but McKenzie chose not to join the YMCA for professional and personal reasons. McKenzie also taught anatomy at McGill, and his appreciation of anatomy, kinesiology, and sports was soon reflected in his art as a sculptor (Figure 1), which would earn him international recognition [14].

Although McKenzie had no specialized training in general surgery or orthopedic surgery after his internship in Montreal, he restricted his practice to orthopedics and musculoskeletal diseases after he joined the faculty of the medical school at McGill. Graduates of Canadian and U.S. medical schools in the 1890s were licensed to practice medicine and surgery after an internship of 1 year. If they restricted their practice to one field, such as orthopedic surgery, on a full-time or almost full-time basis (David B. Levine, MD, personal written communication, June 2014), this validated them as a specialist. McKenzie's earliest publications [15] deal with posture and/or exercises in the prevention and/or treatment of scoliosis, and he is characterized later as an orthopedic surgeon with a special interest in "orthopedic gymnastics" [16].

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Physiatrist Frank Krusen, considered the father of physical medicine [17] claims in his accounts that McKenzie was the first professor of physical therapy in the nation [18], and certainly McKenzie was one of the earliest to hold that appointment in a major U.S. medical school, the University of Pennsylvania, the oldest medical school in the nation. McKenzie's appointment as professor of physical therapy in 1907 [19] followed his appointment as professor of physical education in 1904. His early teaching included instruction in exercises that are applicable to "curvature of the spine [and] locomotor ataxia," included in course work in physical education for medical students [20] at the university. However, the physical laboratory was not established in the hospital for training in hydrotherapy and other therapies as part of medical education until 1911 to 1912 [21]. Archival documents record that "Dr. Joseph Nylin, a trained masseur…-graduated from the University of Pennsylvania" joined the faculty as an associate to McKenzie in 1912 [22]. Sophomore medical students were given a series of lectures twice a week on exercises and massage for specific diseases; additional lectures were given to senior students during medicine and surgery rotations. Demonstrations of hydrotherapy and other physical modalities were added as the curriculum evolved [21].

Because of his dual role teaching physical education and physical therapy, McKenzie was effective in introducing training programs in physical examination and exercise to improve the health and to correct educational deficiencies in the student population. In addition to these innovative contributions to medical education, he made scientific observations and published his findings in the medical literature during these early years at the University [23]. It is during this period that McKenzie began to write his classic textbook on exercise in health and disease. He states his reasons for doing so in the following notation shortly after his arrival at Penn in 1904: "Living in Philadelphia, the home of the leading Medical publishers, and with a seat on a Medical faculty, each member of which had written a standard textbook on his subject, it was natural that the subject of writing would come up early" [19].

McKenzie is in fact approached by a leading publisher and finds that "at the time there are no textbooks on the subject" [19]. Only one book had been published on exercise at that time, Ferrand LaGrange's Physiology of Bodily Exercise [24]. However, McKenzie held the view that "in the realm of medicine…no attempt had been made to give a comprehensive view of the whole subject" [18]. McKenzie's textbook, Exercise in Education and Medicine [3], was first published in 1909 and is regarded by the founders of sports medicine and historians of physical education as a classic [4,25]. It is praised as the "most comprehensive volume" that "brought physical medicine, rehabilitation and athletic knowledge together" [26,27]. Berryman [4] places it with Sargent's book in linking exercise with health and medicine. Part I is devoted to the classification of exercise, massage, physiology of exercise, the German and Swedish schools of exercise, and physical education in schools and for