

NEWS, VIEWS AND COMMENTS

Twin Legacies: Victor and Vincent McKusick / Twin Studies: Twinning Rates I; Twinning Rates II; MZ Twin Discordance for Russell–Silver Syndrome; Twins’ Language Skills / Headlines: Babies Born to Identical Twin Couples; Identity Exchange; Death of Princess Ashraf (Twin); Yahoo CEO Delivers Identical Twins

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The lives of the illustrious monozygotic (MZ) twins, Victor A. and Vincent L. McKusick, are described. Victor earned the distinction as the ‘Father of Medical Genetics’, while Vincent was a legendary Chief Justice of the Maine Supreme Court. This dual biographical account is followed by two timely reports of twinning rates, a study of MZ twin discordance for Russell–Silver Syndrome (RSS) and a study of twins’ language skills. Twin stories in the news include babies born to identical twin couples, a case of switched identity, the death of Princess Ashraf (Twin) and a new mother of twins who is also Yahoo’s CEO.

Twin Legacies: Victor and Vincent McKusick

Anyone who has completed a course in behavioral genetics or medical genetics knows the name Victor McKusick. His seminal volume, *Mendelian Inheritance in Man: Catalogs of Autosomal Dominant, Autosomal Recessive, and X-Linked Phenotypes*, was first published in 1966. This book went into its 12th edition in 1998 as *Mendelian Inheritance in Man: A Catalog of Human Genes and Genetic Disorders*. It is an invaluable compilation of genetic disorders, descriptions, and references. Fortunately, this work is now available online as OMIM.org (Online Mendelian Inheritance in Man), allowing it to be updated annually; the last updating occurred as recently as January 11, 2016.

As a student, I did not know that Victor McKusick had an identical twin brother, a fact I learned only several years ago. I also discovered that his twin, Vincent McKusick, was an illustrious figure in his own right, having been appointed to

the prestigious position of Chief Justice of Maine’s Supreme Court. I was inspired to present an overview of these twins’ lives and accomplishments, having been asked to participate in a panel honoring the McKusick twins at the April 2016 meeting of the American Philosophical Society, in Philadelphia, Pennsylvania. The twins’ life history material comes largely from the news office of Johns Hopkins University where Victor McKusick spent his professional years, and comprehensive reports and articles detailing Vincent McKusick’s legal career; these sources are listed at the end of this section.

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Victor and Vincent

Victor and Vincent McKusick were born on October 21, 1921, in Parkman, Maine. They lived on a dairy farm with their parents, Carroll and Ethel McKusick, both of whom were former educators. The twins were the youngest of five children. They attended the first through eighth grades in a one-room schoolhouse, before becoming co-valedictorians of their graduating high school class of 28 students. Their father, a college graduate and former Vermont school principal, expected his children to go to college. Victor initially considered a career in the ministry, but chose medicine instead — as a teenager he had developed an abscess under one arm and when the infection spread he was forced to spend 10 weeks at hospitals in Maine and Massachusetts. The new drug sulfanilamide finally cured him. This particular experience shaped his ambition to become a doctor and his decision to enroll in Tufts University's premedical program. He never finished that course of study because Johns Hopkins University began admitting advanced premedical students into their medical program due to the shortage of physicians during World War II. Victor entered Johns Hopkins University in 1943, graduated in 1946, and remained there throughout his career.



Victor (left) and Vincent McKusick. Courtesy: Vincent McKusick's family, with assistance from Kami Bedard at Pierce Atwood.

Vincent received his bachelor's degree from Bates College in Lewiston, Maine, and then served in the army from 1943 to 1946 (the exact same years that Victor was completing medical school). While serving, he spent 14 months in Los Alamos, New Mexico working on the Manhattan Project. After the war, Vincent obtained a master's degree in electrical engineering at MIT, then entered Harvard Law School due to his interest in patent law. While there, he became President of the Harvard Law Review, a position that would significantly influence his subsequent career and professional relationships. He graduated magna cum laude in 1950.

Dr Victor A. McKusick

I wondered if Dr McKusick's membership in a MZ twin pair was partly responsible for his career as a medical geneticist, but it was not. As an intern, he treated a teenage boy whose symptoms included intestinal polyps and pigmented spots on his lips. After seeing several such cases and noting their familial nature, Dr McKusick collaborated with another physician (Dr Harold Jeghers) to describe this condition (Peutz–Jeghers syndrome) in his first publication, in the *New England Journal of Medicine*. A Dutch physician, J. L. A. Peutz, had documented the disorder earlier, explaining the name that was finally chosen.

Medical genetics would seem like a natural area for the young doctor to pursue, but that specialty did not exist at the time. While working in cardiology, Dr McKusick came across patients with Marfan's syndrome, leading to his family studies of the condition and the writing of a book on inherited disorders involving connective tissue. He finally launched the field of medical genetics in 1957 when asked to direct Johns Hopkins University's chronic disease clinic. He expanded the program and carried out genetic research of his own among the Amish. He also organized short courses in medical genetics at the Jackson Laboratory in Bar Harbor Maine, in conjunction with the late behavioral geneticist, John Fuller. In 1988, Dr McKusick assumed the presidency of the Human Genome Organization (HUGO) with the mission of mapping and sequencing all human genes. Throughout these years, his seminal volume, *Mendelian Inheritance in Man* (McKusick, 1966) was continually being enlarged and updated.

Among his many honors, Dr McKusick earned the Lasker Award for Special Achievement in Medical Science (1997), the National Medal of Science (2002), and the Japan Prize in Medical Genomics and Genetics (2008). He passed away on July 22, 2008, at the age of 86. A volume, *Victor McKusick and the History of Medical Genetics* (Dronamraju & Francomano, 2012), is a well-deserved tribute to his extraordinary legacy, with chapters contributed by many of his colleagues and friends.

Chief Justice Vincent L. McKusick

According to a 2011 tribute to Justice Vincent McKusick from Maine's Judicial Branch, 'The Chief was an absolutely brilliant man.' I must agree, having reviewed his 59-year career in private practice, appellate court judging and leadership.

Following his graduation from Harvard Law School, Justice McKusick was chosen to clerk for two distinguished jurists: Chief Judge Learned Hand of the United States Court of Appeals for the Second District, and United States Supreme Court Justice Felix Frankfurter. In 1952, he returned to Portland, Maine as a member of the law firm of

Hutchinson, Pierce, Atwood, and Scribner. His reputation as a superb attorney led to his 1977 appointment as Chief Justice — this was a nearly unprecedented event because at that time Vincent McKusick lacked the judicial experience to serve in that role; the only other such appointment had occurred in 1820.

Over the years, Justice McKusick co-authored a classic book, *Maine Civil Practice* (Field & McKusick, 1959), which is still used today. He was also instrumental in reforming administrative procedures and very dedicated to linking legal practice with public service. While serving in private practice, he was regarded as one of the best attorneys in the country. In 1975, President Gerald Ford had considered appointing him to replace Supreme Court Justice William O. Douglas, who was retiring.

Chief Justice McKusick passed away on December 3, 2014 at the age of 93. The praise from his colleagues is overwhelming, despite several acknowledgments that he could be difficult at times. For example, social lunches turned into business meetings — but that happened because Justice McKusick loved what he did. As one colleague wrote, ‘He was exactly the right judge at the right time.’

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Twin Studies

Twining Rates I

The Centers for Disease Control released the latest statistics on US twinning rates in a lengthy 2015 report (Hamilton et al., 2015). The last 30–40 years have seen dramatic increases in the overall twinning rate, from nearly 1 in 60 births (18.9/1,000) in 1980 to about 1 in 30 births (33.7/1000) in 2013. The twinning rate was slightly higher in 2014 (33.9/1,000), with the birth of 135,336 twins. However, while the twinning rate is the highest it has ever been, the highest number of twins born in the US occurred in 2007, with a total of 138,961. The currently increased twinning rate has been attributed to the widespread use of assisted reproductive technologies (ART), as well as older maternal age at conception. In contrast, the triplet rate declined in 2014 because successful ART pregnancies have become increasingly possible with fewer transferred embryos.

Twining Rates II

A new article on twinning rates in developed countries is now available (Pison et al., 2015). The peak period for twinning (MZ and dizygotic [DZ] combined) in developed countries (using data from England, Wales, the United States, France and Japan) is 35–39 years; the relatively older

age range is mostly due to DZ twin births. Twins occurred in 6/1,000 births at maternal ages under 20 years; 15/1,000 births at maternal ages 35–39 years; and 7/1,000 births at ages 45 years and above. Note: This article is a wonderful complement to an earlier paper by members of this research team on twinning rates in developing countries (Smits & Monden, 2011).

Twin Discordance for Russell–Silver Syndrome

I was unaware of this syndrome until I received a telephone call from an affected member of a discordant MZ twin pair. RSS is characterized by slow growth both before and after birth. Infants typically have low birth weights and do not gain weight at expected rates (Genetics Home Reference, 2015). Head growth is normal, so the head appears large relative to the rest of the body. Affected adult males are approximately 4 feet, 11 inches tall (151 cm) and affected females are approximately 4 feet, 7 inches tall (140 cm). Affected individuals are at increased risk for delayed development and learning disorders. The estimated incidence of RSS is 1/75,000 to 1/10,000. Abnormal imprinting of genes situated on chromosomes 7 and 11 has been implicated in this syndrome.

A case report of an affected male triplet with unaffected MZ (male) and DZ (female) co-triplets is informative. The triplets were delivered at 33 weeks gestation to a 23-year-old mother who had experienced preeclampsia (high blood pressure with possible fluid retention). The placenta had two separate diamniotic, dichorionic membranes and three separate 3-vessel umbilical cords. The newborn's size disparities are striking: the affected infant weighed 980 g, and measured 33 cm in length, in contrast with weights and lengths of 1,920 g and 42.5 cm and 1,843 g and 43 cm for his MZ and DZ co-triplets, respectively.

The affected male triplet was referred for medical examination at age six and a half, at which time his height was in the 50th centile for children of age four years, two months and his weight was in the 50th centile for children of age three years, three months. A diagnosis of RSS was based on clinical considerations, which the investigators acknowledged is controversial, but the child's symptoms were consistent with that disorder. Specifically, his difference in birth weight, relative to his male co-triplet, exceeded the average MZ co-twin difference of $242 \text{ g} \pm 154.6$ by 940 g, more than four standard deviations. He also failed to overcome his growth retardation during development and displayed a characteristic triangular face with craniofacial disproportion, hypospadias (opening of the urethra on the underside of the penis), and clinodactyly (curvature of a finger or toe).

Other cases of MZ twins discordant for RSS have been reported (Yamazawa et al., 2008), and a 2010 review noted that six discordant sets and only one concordant set have been described in the medical literature (Eggermann, 2010). Eggermann et al. (2008) have argued that, aside from being the first human disorder involving imprinting abnormalities in genes located on two different chromosomes, RSS is genetically and clinically opposite to Beckwith–Wiedemann syndrome, which involves overgrowth.

Twins' Language Skills

Twins' average language deficits, relative to non-twins, have been well documented (Thorpe, 2006). Explanations for this finding focus on communicative processes within the twin-parent social structure. Compared to ordinary parent-child dyads, twin-parent triads include more interruptions, less individually directed speech and greater parental control when twins are observed at 20 and 36 months of age. These features are even found in the speech styles of mothers talking to their 4-month-old twins (Butler et al., 2003). In contrast, several reports have indicated that twins' language production 'outstripped' that of singletons (Barton, & Strosberg, 1997; Rendle-Short et al., 2015). These studies, while modest in size, stressed the benefits of taking turns, monitoring interactions and mobilizing responses. Looking more closely at how some parents offset twin-associated language difficulties would be worth doing.

Headlines

Babies Born to Identical Twin Couples

Identical twins Niv and Ran Cohen and their identical twin wives Leah and Rebecca became parents on July 23, 2015, just 20 minutes apart (Twin brothers married to twin sisters: 'By virtue of the Tsaddik', 2015; Miracle babies born in Israel to identical twin parents, 2015). Their infant daughters are legal first cousins, but are also the genetic equivalents of fraternal twins, given their time of birth. The two couples, who were married in 2014 just four days apart, live in the Israeli city of Netanya.

Identity Exchange

Fraternal twins can occasionally experience mistaken identity. In September 2015, Marcus McGlothurn of Pasadena, California was brought to the authorities by his mother after allegedly crashing a stolen vehicle (Cardine, 2015). Marcus used his twin's name (Marquise), such that his brother was identified as the suspect. However, e-mail correspondence sent by Marquise to the media indicated that he had been

improperly charged and that it was his twin brother, Marcus, who was responsible for the crime. It turned out that Marcus did not have a driver's license or photo identification, so when his name and date of birth were entered into the record system, his twin brother's information came up. The matter was eventually resolved and the right twin was charged. The twins appear to be fraternal from their photographs, but show some physical resemblance; this may have contributed to the confusion.

Death of Princess Ashraf Pahlevi (Twin)

The death of Princess Ashraf Pahlevi, twin sister of the former Shah Mohammed Reza Pahlevi of Iran, was announced on January 7, 2016 (Voice of America, 2016). The princess was age 96 and had been living in exile for years; state television reported that she was in Monte Carlo.

The twins were born on October 26, 1919 to a family that came into power in 1921, following a coup orchestrated by Great Britain. Their father, Reza Shah, was forced to relinquish his position following a 1941 invasion by Russia

and Great Britain. A popular prime minister followed, but was overthrown, allowing Princess Ashraf's twin brother to assume leadership of the country. Some people believe that the princess was behind this takeover, as well as events that occurred during her brother's administration.

Yahoo CEO Delivers Identical Twin

Marissa Mayer, CEO of Yahoo, delivered identical twin girls in December 2015 (Snyder, 2015). She announced her multiple birth pregnancy in September of that year, indicating great surprise because she claims to have no family history of twinning or other predisposing factors. Recent studies suggest that there may be a genetic component to identical twinning, but only in certain families (Lichtenstein et al., 1996) and communities (Cyranoski, 2009). The rate of identical twinning is fairly constant worldwide (0.3%) and its underlying causes continue to be debated (Herranz, 2013).

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