The Life of Hubert J. P. Schoemaker (1950–2006)

An Oral History

Edited by

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Preface: Reading *The Life of Hubert J. P. Schoemaker*

This book tells the story of Hubert Schoemaker's life. More than sixty friends, family members, and colleagues were interviewed about their interactions with Hubert, and snippets of their recollections have been combined to create a narrative that describes Hubert's life from his birth in 1950 until his passing in 2006.

The book is intended to read as if these individuals were all in a room together, recounting their shared experiences with Hubert. A list of their names and relationships to Hubert has been included in an appendix for reference purposes. In addition, the editors have interspersed some narrative text throughout the manuscript for context.

Please enjoy the remarkable history of Hubert Schoemaker—a pioneer in both the biotech industry and his own life.

Acknowledgments

This unique oral history is really the shared remembrances of Hubert's family members, friends, associates, and coworkers. We thank them all for their generous commitment of time and energy.

A special thanks is extended to Anne Faulkner Schoemaker for making family photographs available and for her ongoing advice regarding the formulation of this document.

We also would like to recognize the efforts of Patricia Wieland, who edited our draft manuscript, and the other members of CHF's publications group, including Mary Ellen Burd and Shelley Geehr for their technical assistance.

Finally, we are greatly indebted to those who underwrote the cost of the project, including Cephalon, GlaxoSmithKline, and Johnson & Johnson, the parent company of Centocor.

Introduction

By Lara Marks and Ted Everson

Hubert Jacob Paul Schoemaker (March 1950–January 2006) was one of the first generation of biotechnology entrepreneurs. He was a cofounder of Centocor (established in 1979), the first company successfully to commercialize monoclonal antibodies for therapeutic purposes, and the founder of Neuronyx (established in 1999), the first company to manufacture stem cells on a large scale and thereby enable the development of stem-cell therapeutics. Hubert's vision, mentorship, and guidance were instrumental in building a biotechnology community not only in southeastern Pennsylvania, but also nationally and internationally.

This is the story of Hubert's life, told by those who knew him best: family, friends, colleagues, employers, and employees. In their own words the contributors to this book capture the essence of Hubert's vision, his entrepreneurship, his strength, his charm, his exuberance, his kindness, his boundless optimism, and his ability to inspire. Through the stories of those who knew him, along with information from primary documents, this book poignantly describes a man who met and surmounted many challenges, both personally and professionally.

Born on 23 March 1950, Hubert came from a Dutch family with a long tradition of risk taking and entrepreneurship. Of German origin, the Schoemakers made their living in the nineteenth century through trading horses to the German army. During World War II Hubert's father, Paul Schoemaker, Sr., made the courageous decision to leave his physics studies at Delft University and join the resistance movement, helping forge passports and find escape routes for people fleeing the Nazi occupation. After the war Hubert's father became a well-established businessman, building with a partner a successful international company, Vaessen-Schoemaker, that manufactured chemicals, food additives, and other products.

Hubert grew up in Deventer, an industrial town in the eastern part of the Netherlands with a population of about a hundred thousand. The second of five children, he first attended a local Catholic school, St. Bernardus School, Gemeente, in Deventer, and later was enrolled at Canisius College, a Jesuit boarding school in Nijmegen, a couple of hours from home. At the age of eighteen Hubert made a decision unusual among his peer group to attend a university in the United States, abandoning his original plans to study engineering at Delft University. In 1969 he enrolled as a chemistry major at Notre Dame University and was graduated in May 1972 at the age of twenty-two. Two months later, he married Ann Postorino, an American student majoring in biology at Saint Mary's, a sister college to Notre Dame.

On leaving Notre Dame, Hubert decided to go to the Massachusetts Institute of Technology (MIT), which offered him a substantial fellowship and the chance to continue scientific research at the doctoral level, something he had wanted to do ever since he had spent his spare time working in the laboratory of Charles Bramble at Notre Dame. Completing a Ph.D. in biochemistry in three years as opposed to the usual five years, Hubert worked under the guidance of Paul Schimmel, a leader in the study of the genetic code and the mechanism of

protein synthesis. Schimmel's laboratory team focused on transfer RNAs (tRNAs), small RNA molecules that transport amino acids to cellular structures called ribosomes, the sites of protein synthesis.

When Hubert joined Schimmel's laboratory tRNAs were a hot topic, and MIT was a leading center for their study. Hubert therefore found himself immersed in a rich, cutting-edge research program that brought him into contact with many scientific luminaries, including Alexander Rich, best known for his discoveries of the three-dimensional structures of tRNA and Z-DNA and for codiscovering double-stranded RNA in 1956; Har Gobind Khorana, the 1968 Nobel laureate in physiology or medicine who worked on the interpretation of the genetic code and its function in protein synthesis; and David Baltimore, cowinner of the 1975 Nobel Prize in physiology or medicine for research on the interaction between tumor viruses and the genetic material of the cell. The basic research being carried out by these individuals awakened in Hubert a strong desire to find a means of commercializing this work.

Excited by the intellectual and scientific atmosphere at MIT and with several publications to his name, Hubert seriously considered becoming an academic scientist after completing his doctorate. He applied and was accepted for postdoctoral research positions in the MIT laboratories of Schimmel and Alexander Rich, as well as that of Stanley Cohen at Stanford University.

Hubert, inspired by his father's entrepreneurial example, decided instead to pursue a business career. At Notre Dame he had explored the possibility of getting a business degree before opting for chemistry, and he completed economics courses while majoring in chemistry. On being graduated from Notre Dame he had applied and been accepted to Harvard Business School. Although he turned down the place at Harvard, in part because it was too expensive, he had sat in on courses at MIT's Sloan School of Management while working on his Ph.D.

Beginning in May 1975 Hubert searched for a position in a wide range of companies, including electronics, fiberglass, auto parts, and manufacturing, and in February 1976, two months after finishing his doctorate, he accepted a position at AIM Packaging, a low-tech manufacturing company in Springfield, Massachusetts. AIM was owned by a business partner of Hubert's father and managed by Peter Maher. While it was clear that Hubert was overqualified for the job, he viewed the position as his chance to learn entrepreneurial skills in a small-company setting.

After four months of employment, however, Hubert left AIM owing to the health problems of his first child, Maureen. Born in mid-January 1976, shortly before Hubert started at AIM Packaging, Maureen was soon diagnosed as having lissencephaly, a rare brain malformation causing severe mental disability and motor dysfunction. Maureen's condition made Hubert rethink his position. By the time of Maureen's diagnosis Hubert and his wife, Ann, had incurred a very large debt for Maureen's medical care. Hubert wanted work that could better provide financially for Maureen's long-term needs and be more conveniently located near appropriate medical facilities in Boston. Maureen's condition also strengthened in Hubert a strong desire for a career that could make a difference and have a positive impact on people's lives.

At the time of Hubert's departure from AIM a prestigious postdoctoral research position became available to Hubert with Klaus Weber, who had just moved to Göttingen in Germany from Harvard, to become director of the Department of Biochemistry and Cell Biology at the Max Planck Institute for Biophysical Chemistry. The post was particularly attractive given that Weber had worked with James Watson, codiscoverer with Francis Crick of the DNA double helix, and Walter Gilbert, inventor of DNA sequencing. After some hard thinking Hubert opted instead to take a job as a research scientist with Corning Medical, a Boston-based division of Corning Glass Works. At the time Corning Medical was just beginning to develop diagnostic immunoassays, the newly emerging diagnostic techniques rapidly replacing the more traditional chemical-based tests that had dominated the diagnostics market since the 1940s. Built around antibodies, components of the body's immune system produced to inactivate invading antigens (foreign molecules, viruses, or cells) and other proteins, immunoassays provided a new means of measuring blood concentrations of various substances in the body. Antibodies are particularly good tools for diagnostic purposes because they are highly specific and will recognize and bind to unique antigens. Immunoassays use the antibody-antigen reaction to measure the concentration of a given antigen in the body. Hubert took the lead in inventing several revolutionary new diagnostic tests based on immunoassays at Corning Medical, tests for hyperthyroidism, hypothyroidism, and cortisol. One of the most important of these was the free T4 assay, which continues to this day to be used for measuring blood thyroxine levels, an indicator of hyperthyroidism. Hubert solved a major impasse in the development of the free T4 assay, which spurred Corning Medical's subsequent successes in the emerging field of immunoassay development.

While at Corning, Hubert worked with Ted Allen, one of the company's marketing managers for immunoassay tests. This contact was to prove important to Hubert's later career. In 1978–1979 Ted left Corning and joined a new venture with Michael Wall, an MIT-educated electrical engineer and entrepreneur who had founded several high-tech companies. In the mid-1960s Wall had cofounded a medical-equipment company called Flow Laboratories, which was sold in 1969 to the Virginia-based biomedical company General Research Corporation. Remaining with the company after its sale and running it as a subsidiary for General Research Corporation, Michael began searching for entrepreneurial opportunities in biotechnology. He came into contact with the Polish virologist and immunologist Hilary Koprowski, longtime head of the Wistar Institute in Philadelphia and one of the few scientists in the United States then working with a new technology for antibody production known as hybridoma technology, which was opening up new commercial possibilities.

For years scientists had been interested in finding a means to isolate and reproduce individual antibodies for research, diagnostic, and therapeutic purposes. The key difficulty was figuring out a way to isolate an individual (monoclonal) antibody from the billions produced by the immune system. In 1975 Walter Gerhard and Norman Klinman, researchers based at the University of Pennsylvania and connected to the Wistar Institute, published a paper outlining the first successful production of monoclonal antibodies. This procedure involved irradiating mouse spleens, thereby destroying their antibody-producing capability, and then injecting them with new antibody-producing cells, some of which lodged in the spleen. The spleen was then cut into cubes and individually grown using tissue-culture techniques. Antigen was then added to the cultures. If an antibody-producing cell was present within a given fragment, it would produce antibodies very specific to that antigen, which could then be isolated from the culture medium.

This “splenic fragment” technique enabled for the first time the production of monoclonal antibodies, but the antibody-producing fragments survived for less than two months, making them unsuitable for use as a general research and therapeutic tool. Soon thereafter, in May 1975, Georges Köhler and Cesar Milstein, both based at the British Medical Research Council’s (MRC) Laboratory of Molecular Biology at Cambridge University, submitted an article to *Nature* outlining a technique to produce “immortal” monoclonal antibody–producing cells that could survive in cell culture indefinitely. Köhler and Milstein combined an immortal bone-cancer cell with an antibody-producing cell, creating a hybrid cell with the properties of both of the original cells that had the ability to survive indefinitely and produce antibodies. They then injected this “hybridoma” cell into irradiated mice, injected an antigen to stimulate antibody production, and isolated the resulting monoclonal antibodies.

Köhler and Milstein pointed to the commercial possibilities of their monoclonal antibodies in their *Nature* article, indicating they “could be valuable for medical and industrial use.” The potential commercial value of their technique was also noted by an MRC official at an internal meeting in 1975 who informally contacted the National Research Development Corporation (NRDC), the body responsible for patenting MRC inventions, to see whether the new hybridoma technology could be patented. The NRDC, however, responded that while they recognized the possible medical and commercial value of Köhler and Milstein’s work, it was difficult to “identify any immediate practical applications which could be pursued as a commercial venture.” The letter continued: “Genetic engineering is a particularly difficult area from the patent point of view. . . . Unless further work indicates a diagnostic application or industrial end product which we can protect . . . , we would not suggest taking any further action ourselves.” The fact that Köhler and Milstein had published their work also prevented their application for a British patent. In contrast to U.S. patent law British law only grants patents before publication.

While British authorities were debating the merits of patenting Köhler and Milstein’s work, their technique was being adopted across the Atlantic. Using some myeloma cells donated by Köhler and Milstein, Koprowski and his team at the Wistar Institute began a research program to develop monoclonal antibodies for various therapeutic uses. In 1977 Koprowski, Gerhard, and another Wistar-based scientist, Carlo Croce, published a paper outlining a procedure to produce monoclonal antibodies against the influenzavirus. This paper, together with further research into the creation of antibodies directed against tumors, formed the basis of two patent applications by Koprowski and his colleagues.

When applying for the patents, Koprowski started to search for a means to commercialize applications of monoclonal-antibody technology targeting viral and tumor antigens. One of the first companies he approached with the technology was Boehringer Ingelheim, a large chemical-pharmaceutical company in Germany. The company was offered a license to the technology for $500,000 per year for ten years. When the deal failed to materialize, Koprowski instead formed a partnership with Michael Wall to create a company to market the technology.

For eighteen months Wall directed the company, which was called Centocor, from a five-room suite on Market Street in Philadelphia, with scientific input from Koprowski and Croce. From those offices Wall began to build an executive team to help manage the operation. One of the first to join the executive group was Corning’s former marketing manager, Ted Allen, who became Centocor’s first president and chief executive officer. In

mid-1979 Hubert was approached to join the company because of his contact with Ted Allen. Hubert soon agreed, inspired in part by the dealings he himself had had with Wall at Corning and the familiarity he had of Koprowski's work. At first Hubert joined Centocor in an unofficial capacity, helping with the company's research and planning while retaining his position at Corning Medical in Boston. In August 1979 Vincent Zurawski, on Hubert's recommendation, was hired as the company's first chief scientific officer. Zurawski came well equipped for the post, having been a postdoctoral student at Massachusetts General Hospital (MGH) where he had worked with immunologist Edgar Haber on different methods of monoclonal-antibody production. On joining Centocor, Zurawski moved to Philadelphia and began collaborating with Hubert on Centocor's first scientific project, a monoclonal antibody–based hepatitis B surface-antigen assay. In April 1980 Centocor received its first round of funding from several groups, and Hubert was officially appointed Centocor's head of manufacturing and operations, a similar position to the one he had held at Corning Medical.

During the initial stages of its evolution Centocor's executive team was divided between two cities: Ted Allen and Hubert were in Boston, while Wall, Koprowski, and Zurawski were in Philadelphia. With Allen and Hubert located in the Boston area and with Zurawski's network of scientific collaborators at MGH, the headquarters of the company was originally planned to be located in Boston. The situation changed, however, in early 1980 when Allen unexpectedly left and the fledgling executive structure had to be reorganized. The decision was made to base the headquarters in Philadelphia. With Allen's departure Hubert was appointed CEO, necessitating regular departure from his family in Boston from Monday to Friday to join the remainder of the executive team in Philadelphia. In late September–early October 1980 Hubert and his family moved to Philadelphia in order to cut Hubert's commute and to reduce the time he was spending away from home. At the time of the move he and his wife had three young daughters: four-year-old Maureen, three-year-old Katherine, and Annie, just six weeks of age.

With the new executive in place Centocor's team began to roll out the company strategy. From the start the founders envisaged Centocor becoming both a diagnostics and a therapeutics company. Both were ambitious goals. The $2 billion diagnostics market was highly competitive, dominated at that time by health-care giants like Abbott Laboratories, Hoffmann–La Roche, and Warner-Lambert, all of which generally had developed tests that required their own proprietary instruments in order to be analyzed. Further, by 1981 both big pharma and new start-ups were entering the rapidly growing hybridoma diagnostics market, which by 1982 had grown to $14 million and was predicted to reach anywhere from $250 million to $500 million by 1985 in the United States alone. In an early investment prospectus the Centocor team noted that two companies were already offering hybridomas on a commercial basis: Hybritech, in San Diego, and Sera Lab, a British company. By the end of 1983 Centocor was facing serious competition: over 150 companies had created research-and-development programs for immunodiagnostics, 23 monoclonal antibody–based diagnostics were on the market, and another 100 were predicted to become available.

Therapeutics at that time were an even bigger uncertainty; the idea of producing monoclonal antibody–based therapeutics was completely novel. Much of the commercial attention in the nascent biotechnology-therapeutics industry focused on the development of therapies using recombinant-DNA technology for the production of drugs for which there were existing markets. Genentech, for example, had already cloned recombinant insulin for diabetes

treatment and was collaborating with Eli Lilly for its manufacture. Therapies based on monoclonal antibodies remained uncharted territory.

Centocor's founders decided to focus resources initially on the development of diagnostics, predicting $17 million in revenues by 1984, and to maintain an interest in therapeutics as a longer-term strategy. Their aim was both to develop diagnostic products and to provide contract services, offering antibodies to other companies for use in developing diagnostic kits. Several additional strategies were adopted: first, rather than attempting to distribute its diagnostics itself, Centocor relied on licensing agreements with companies that had established market channels and a market position so that it could focus its efforts on research and development, manufacturing, and some marketing support. Second, Centocor created diagnostic tests that were compatible with existing analyzers on the market, notably Abbott: in fact, all Centocor's early diagnostics, up to about 1990, were designed to be compatible with Abbott's instruments, which were used by the majority of clinical laboratories. The strategy quickly provided Centocor with a market for their diagnostics. Third, rather than depending solely on in-house research, Centocor drew heavily on licensing promising technologies from universities and other research institutes, a strategy pursued by many early biotech companies but employed with exceptional gusto at Centocor. As Wall told *Forbes* in May 1985, "You can have a garage full of Ph.D.s working on a project, and nine times out of ten some guy across the street is going to come up with the discovery that beats them all." In deploying this strategy Centocor, like the rest of the biotechnology industry, was helped enormously by the passing in late 1980 of the Bayh-Dole Act, which for the first time allowed universities, research institutes, and small companies to patent and commercialize government-funded research.

In the early years this in-licensing strategy allowed Centocor to keep its costs to a minimum while increasing sales: between 1984 and 1990 Centocor's R&D budget remained at the same level while its sales increased fivefold. By 1990 Centocor had close ties with some eighty universities internationally and had signed license agreements with many of them. Some of Centocor's earliest in-licensing partners were the Wistar Institute, the Dana-Farber Center, and Massachusetts General Hospital; these institutions provided Centocor with research materials that became some of the company's most important early products.

In order to generate revenue and thereby ensure the company's growth Centocor marketed its diagnostics as rapidly as possible. For example, CA 19-9, for detecting gastrointestinal cancer, was one of the first diagnostic tests for which Centocor received approval. The test was developed and approved in just eight months, receiving the go-ahead for clinical use in Europe in 1982. By early 1983 the company had also gained U.S. Food and Drug Administration (FDA) approval for a hepatitis B monoclonal immunoassay, based on Zurawski's work at MGH and Centocor. In mid-1987 Centocor won FDA approval for CA 125, a blood-based diagnostic test for ovarian cancer. As the first diagnostic tool available for the disease, this test represented a major step forward in treatment. By 1990 the company had three more monoclonal assays on the market: CA 15-3 for breast cancer, CA 72-4 for gastric cancer, and P-glycoCHEK C219, the first immunologic test for multidrug resistance, a major problem for cancer patients. In addition, Centocor had three in-vivo radioimmunoassays in development that were planned to be distributed by Johnson & Johnson's McNeil Pharmaceutical Division: Myoscint, for assaying dead heart tissue after a heart attack; Fibriscint, for detection of blood clots; and Capiscint, for the detection of atherosclerotic plaques.

By the mid-1980s Centocor's team was exploring the possibility of diversifying away from the diagnostics sector toward the therapeutics market, with the goal of becoming a fully integrated pharmaceutical company. As early as 1981 Centocor had begun to investigate the possibilities of deploying monoclonal antibodies for therapeutic purposes, carrying out preclinical studies of 17-1A, an antibody licensed from the Wistar Institute. Following animal studies of efficacy the antibody was given to a terminally ill cancer patient at the Fox Chase Cancer Center—the first patient administration of an antibody. During the trial the patient showed negative immunoreactions to the antibodies, a side effect anticipated before the trial's initiation. The patient died shortly after the trial ended. The trial, however, provided key data about the future administration of antibodies to humans, with the most important finding indicating that antibodies should not be infused too fast. A subsequent trial conducted at the Fox Chase Center showed that the antibody could detect metastases in vivo, thereby providing an important path toward the development of a therapeutic.

By 1986 Centocor was testing two antibodies as potential drugs: 17-1A (Panorex) for colorectal cancer and the antibody HA-1A (Centoxin), licensed from the University of California, San Diego, for treating septic shock, a deadly disease caused by gram-negative bacterial infections usually acquired in hospitals and traditionally treated—ineffectively—with antibiotics. Of the two, Centoxin quickly became the company's preferred lead product: many of Centocor's competitors were focusing on cancer therapeutics research, which Centocor believed would take much longer to achieve. Further, gram-negative infections were the third leading cause of death in the United States, with more than a hundred thousand people dying from sepsis each year and accounting for up to $10 billion in health-care expenditures annually. Centocor's executive group therefore believed Centoxin filled a critical medical need and could become a major blockbuster. The market for products to treat septic shock was estimated to exceed $300 million in 1990.

To maximize the potential of Centoxin the company's executive group made the decision to internally develop and market Centoxin rather than sell the rights to the drug to another company, as other biotechnology companies such as Genentech had done for their initial lead drugs. This shift, however, required major changes to the regulatory, manufacturing, and marketing structure of the company and substantial sources of capital. Centocor's executives estimated that they needed at least $150 million to get the drug to market. As part of the effort Hubert and his team began a drive to raise money. Between 1986 and 1992 Centocor went through nine different equity, debt, and off-balance sheet financings, netting more than $500 million. Of this money $450 million had been spent by September 1991 in research trials for Centoxin and in the process of building the company's sales force and manufacturing facilities. By 1992 Centocor had a sales force of 275 people (200 in the United State and 75 in Europe) and had two new factories, one in Holland and one in the States.

Centocor's management team was also restructured to bring on board skills in pharmaceutical development and marketing. In December 1987 Centocor hired James E. Wavle as its president and chief operating officer. Before joining Centocor, Wavle had served as president of Parke-Davis, the pharmaceutical unit of Warner-Lambert, and was responsible for manufacturing, marketing, and sales, as well as worldwide pharmaceutical research. Working together with Hubert, who retained his position as CEO and replaced Michael Wall as chairman, Wavle took a leading role in moving Centocor toward its ambition of becoming a global integrated pharmaceutical company. By 1989 journalists

were quoting Hubert as saying that Centocor intended to become “a Merck” by the year 2000. Two years later Hubert was quoted as predicting that Centocor’s sales would be in excess of $1 billion and that the company would have more than 50 percent of the share of the antibody pharmaceuticals market in Europe, the United States, and Japan by the year 2000.

Within Centocor and the financial community, hopes were running high that Centoxin would be a success. In February 1991 the *New England Journal of Medicine* ran an article indicating that Centoxin reduced gram-negative sepsis by 39 percent. For those who went into septic shock the drug reduced mortality by 47 percent. That same month some supplies of the drug were given to the U.S. Army to be used among soldiers fighting in the first Gulf War. In March 1991 the European Community’s Committee for Proprietary Medicinal Products recommended approval of Centoxin for the treatment of gram-negative bacteremia. Six months later, in September 1991, an FDA panel recommended that Centoxin be approved for marketing for septic-shock treatment.

Only a couple of weeks later, however, signs of trouble began to emerge. In late October 1991 a federal court ruled that Centocor’s patent for Centoxin infringed a patent held by XOMA Corporation, a competitor biotechnology company based in California that was developing a similar drug for septic shock. The dispute with XOMA over the patents not only cost Centocor dearly in terms of time and money but also aired public questions about the design of Centoxin’s trials and the data analysis. In addition, some medical practitioners began to voice concerns in late 1991 about the potentially high price of Centoxin (between $3,000 and $4,000 per patient) and the degree to which they could tell ahead of time which patients would be most likely to benefit from the drug. By early 1992 European sales of the drug were beginning to be analyzed, indicating sale numbers were far below expectations.

More bad news was to follow when on 20 February 1992 the FDA requested additional information from Centocor about Centoxin. The news triggered shock in the financial community, with Centocor’s shares tumbling 19 percent, or $8.125 a share, closing at $33.125 a share. Only two weeks before, the stock had traded at $50 a share. The slide in Centocor’s share represented a $675 million drop in its market value. Just three months later, on 15 April 1992, Centocor faced a bigger blow when the FDA indicated that it would not approve Centoxin because there was insufficient evidence to establish its efficacy. The FDA called on the company to undertake more trials before it would consider approval. Centocor’s stock plunged $12.25 to $19 within hours of the news. In the week that followed, disgruntled investors filed six lawsuits against Centocor and its executives alleging violation of federal securities laws and calling for damages. Nicknamed “Centocorpse” by Wall Street, Centocor faced financial disaster. Sensitive to the calamities of one of its leading companies, the biotechnology industry suffered its own financial aftershocks with the news.

As Centocor’s chief executive, Hubert was at the forefront of the crisis. Not only was the financial future of the company at stake; so were hundreds of its employees’ livelihoods. Centoxin’s failure might have crushed lesser spirits, but Hubert together with Wall crafted a strategy to save the company, shifting its focus away from operating as a separate company back to its earlier model, which emphasized development in collaboration with partners. One of the first things they quickly realized was they would have to lay off hundreds of people to stop the company’s rapid cash burn. Within a very short period a wave of employee terminations reduced the company from 1,600 to around 400 employees. Hubert took on the

painful task of delivering the devastating news to many of these employees himself, including those based in Holland, a difficult and overwhelming task for someone who had dreamed of success for his company. Most of the layoffs were of the sales representatives hired in anticipation of Centoxin's launch. The management of the company was also shuffled. On 28 April 1992 Wavle resigned, and David Holveck, Hubert's longtime friend from Corning days who had joined Centocor in 1983 to head its diagnostics division, was brought in to manage operations.

At the same time Centocor's staff was being reorganized, Hubert plunged into a frenzy of fund-raising efforts with Wall to rescue the company. In May 1992 Hubert and his team began discussions with Eli Lilly to see whether an alliance could be forged. A licensing agreement was finalized with Eli Lilly in July 1992 for both Centoxin and ReoPro, a Centocor cardiovascular drug that at the time was in its early developmental stages. Under the agreement Centocor was to receive $100 million upfront from Eli Lilly and a further $25 million as part of the option agreement for ReoPro.

Despite these remarkable achievements in the summer of 1992, Hubert, sensing that his role in the buildup to Centoxin might have damaged both his credibility and the ongoing credibility of Centocor, made the extremely difficult personal decision to step down from his position as chief executive, which he had held since 1980. In Hubert's place David Holveck was appointed chief executive and president. Hubert retained his position as chairman.

Clinical trials with Centoxin were resumed in June 1992 but were halted in March 1993 owing to poor results. At this point, however, Centocor was focusing its energies on ReoPro, which in March 1993 was proving successful in clinical trials: it reduced blood clots by 40 percent in patients after high-risk coronary angioplasty. The day these results came through, Hubert and his team realized that they had developed a successful and life-saving drug, and, just as important, they had a company with a future. After completing further clinical trials, in February 1994 Centocor submitted ReoPro for approval to the FDA, with final granting in December 1994. The approval marked a key milestone for Centocor and a major turning point for what monoclonal antibodies could achieve as therapeutics. ReoPro rapidly became a success, with worldwide sales of $23 million in its first year, 1995. By 1999 worldwide sales were reported at $447.3 million. Following this success Centocor soon had another major drug and therapeutic breakthrough. In 1998 Centocor won approval for its drug Remicade to treat Crohn's disease. The same drug was approved for rheumatoid arthritis in 1999. Today the drug is a blockbuster and has received approval in eighty-eight countries for fifteen inflammatory-disease indications, including psoriasis, ulcerative colitis, and ankylosing spondylitis, and is being used to treat over 1 million patients worldwide. In 2006 the drug generated $3.77 billion in worldwide sales.

In February 1994, just as the storm from Centoxin was fading and the positive results from ReoPro were emerging, Hubert was settling into a new family life with a new partner, Anne Faulkner, his first wife having left him and his children in 1989. That month, however, Hubert experienced a personal crisis: he was diagnosed with medulloblastoma, a brain cancer found normally in children but occurring rarely in adults. On being told shortly after he was diagnosed there were only ten adult survivors of this type of brain tumor in the United States, Hubert with his characteristic optimism vowed to be the eleventh survivor. Hubert fought the cancer aggressively with radiation and high-dose chemotherapy followed by stem-cell bone-marrow transplantation. At first the treatment seemed to work, but two

years later, in 1996, he experienced a recurrence. Faced with a poor prognosis, Hubert underwent what was for that time an unprecedented second round of high-dose chemotherapy for adults. By the end of 1996 Hubert was free of the brain tumor, but in subsequent years he had to be hospitalized numerous times as a result of the profoundly debilitating physical and sometimes life-threatening side effects caused by his cancer treatment.

Despite the setbacks to his health Hubert courageously continued to work at Centocor and live life as normally as possible, helping lead the Eastern Technology Council, a body that Hubert helped found in 1990 and that promotes technology and life-science companies in the Pennsylvania region. He also continued to be cochairman of the Board of the Technology Leaders Venture Capital Fund, which he had founded in 1992 and which provides pivotal funding to hundreds of companies in the region. In June 1996, having just come out of the hospital, where he had been for three weeks owing to side effects from his second round of chemotherapy, he delivered an impromptu speech to an audience of about eight hundred people when honored for the work he had done in the Philadelphia region to promote the establishment of new companies and raise venture capital. The same month he married his second wife, Anne Faulkner. In January 2005 Pennsylvania Bio awarded Hubert the first-ever Lifetime Achievement Award for his many contributions to the growth of the life sciences in Pennsylvania and renamed its annual leadership award the Hubert J. P. Schoemaker Leadership Award. This award is used to recognize outstanding contributions by a new generation of leaders in the life sciences.

In 1999 Centocor was sold to Johnson & Johnson for $4.9 billion. At this point Hubert might have decided to slow down. Instead in February 2000 he chose to launch a new company, Neuronyx, to use breakthroughs in stem-cell research to develop cellular therapeutics for such neurological conditions as multiple sclerosis, Alzheimer's disease, and Parkinson's disease. He was not the first to enter the stem-cell field. During the 1980s a number of companies, predominantly in the United States, had been established to commercialize stem cells, inspired in part by a technological breakthrough by the pediatric oncologist Curt Civin and his team at John Hopkins University. Since the 1950s, researchers had been investigating bone-marrow cells and their use in the treatment of leukemia and innate immune deficiencies. Finding that the bone-marrow cells were able to generate different blood cells, researchers began to look for a way to identify, isolate, and characterize these cells. They started to focus on the bone marrow's master cells, known as hematopoietic stem cells (HSCs). In 1981 Civin, looking for a way to improve the success of bone-marrow transplant treatments in leukemia patients, began to investigate HSCs as a means of providing cells that were cancer-free and safe for patients' immune systems.

Between 1982 and 1993 at least six stem-cell companies were formed, focusing primarily on the purification and genetic modification of HSCs. By the mid-1990s three of these companies, all based in the United States, were trading on the public markets and between them had at least five hundred employees. By the end of the 1990s, however, doubts about the commercial viability of the technology began to set in when some clinical and technical setbacks and legal challenges occurred.

While not the first to set up a stem cell–based company, Hubert's founding of Neuronyx came at a time when many of the pioneer stem-cell companies had collapsed. Within a year of creating Neuronyx, Hubert had managed to raise $10 million in funding, an achievement all the more remarkable given that this was a time of economic recession and many pharmaceutical companies were pulling away from investing in stem cells. At the time Neuronyx was founded, there was just a handful of companies focusing on stem cells.

Hubert believed stem cells could provide a platform in the same way that monoclonal antibodies had done. During the late 1990s many of the companies looking to produce stem cells aimed to grow embryonic stem cells from placentas and fetuses. Initially the scientists at Neuronyx evaluated several sources of stem cells, including embryonic, neuronal, and bone marrow–derived cells. It quickly became apparent, however, that embryonic stem cells posed teratogenic problems as well as quality-control ones, and Hubert foresaw that the technology might face problems given the religious and political controversies then emerging. Neuronyx's scientists also looked at neuronal stem cells, but these proved difficult to differentiate and manufacture in large quantities.

During the evaluation stage Hubert emphasized to Neuronyx's scientists that they should find a stem-cell line that would provide the key to large-scale manufacture of high-quality cells that could be used for multiple indications. He advised that they should follow the guidelines in place for monoclonal-antibody production. Within a month of opening laboratory operations the scientists at Neuronyx were evaluating adult bone-marrow stem cells (hABM-SCs), and it soon became apparent that they could provide a source of pure stem cells necessary for large-scale manufacture. By February 2001, just one year after the company had been officially launched, the scientists had devised a process enabling them to grow hABM-SCs on an unprecedented scale. This technique marked a major breakthrough because most researchers in the field were having a very hard time growing stem cells. Moreover, by April 2001 Hubert and his team discovered that hABM-SCs had much greater plasticity than had heretofore been imagined, which meant they could be made into many different types of body cell. They quickly spotted, however, that the cells behaved best when they were not manipulated and could stimulate the body's own regenerative tissue process. On this basis the team began to explore how the technology might be used to repair various parts of the body, including lungs, kidneys, skin, and bone.

Neuronyx filed for a patent for the technology in September 2001. By November 2001 the cells were being investigated in animals for a variety of purposes. Within a year the company began five major preclinical programs investigating the cells for their use in acute myocardial infarction, spinal cord injury, brain cancer, and Parkinson's disease, and for generating pancreatic insulin. Despite this rapid progress Neuronyx was in desperate need of cash. In late 2001 Hubert managed to secure a collaboration with Johnson & Johnson, based in part through his close previous connections with the company, to fund an investigation into the use of Neuronyx's cells for the development of a drug for myocardial infarction. While the partnership ended in 2005, the alliance enabled Neuronyx to progress to the point where it submitted its first investigational new drug application in March 2006. The application was for a phase-I trial to investigate Neuronyx's drug called NX-CP105 for its capacity to regenerate cardiac tissue after a myocardial infarction. Results from this trial are only just coming in, but the data look promising.

Having championed the cause of Neuronyx and brought its team to the point of developing a successful and powerful new technology that had therapeutic potential, Hubert was sadly forced to take a back seat after January 2003 when he suffered debilitating injuries as a result of a fall. By this point the side effects of his cancer treatment were also taking a heavy toll on his mental and physical abilities, which sapped his drive and energy to continue. Neuronyx suffered greatly as a result of his diminished presence. Struggling to raise the necessary cash to keep going and lacking its dynamic leader, Neuronyx lost many of its key scientific staff members in 2003. Despite these setbacks the company's technology, developed in part as a result of Hubert's perceptive insights from his involvement with monoclonal antibodies and Centocor, holds great promise for the future.

Hubert not only left behind what might one day prove to be a powerful tool to treat neurological disorders; he also championed the importance of ensuring that those suffering from an illness or disability had the opportunity to live life to their full potential. Much of his energy in this field was driven by the experiences he had with his profoundly physically and mentally disabled daughter Maureen. For almost all her life Maureen has lived at the Melmark Home, a facility that provides comprehensive residential, educational, therapeutic, and recreational services for children and adults with developmental disabilities. Hubert was a generous devotee and benefactor of Melmark, providing financial support and serving on its board of directors to the end of his days. His work has inspired many others to contribute to this cause. In 2006 Hubert's friends and colleagues set up an annual golf tournament to raise funds for Melmark.

In his remaining years Hubert bore the indignities and suffering of his illness with great courage, inspiring all who knew him with his enormous optimism and spirit. For those who had known him as someone with a powerful intellect and great athleticism, his increasing physical and mental disabilities were painful to watch, but even in his darkest moments Hubert managed to remember other people and was grateful for even the smallest of gestures. Just as he had been an important mentor to those in the biotechnology industry, his positive attitude to his illness and his ability to rise above all the indignities it imposed provide an important beacon to those facing similar plights. What carried him through was his strong Catholic faith and unwavering belief that he was one of the luckiest people to have lived. Right to the end of his life he would wake up every morning and say, "Just call me Mr. Lucky."

Oral History Interviewees

Lee Ahrensdorf: Hubert's tennis partner, search firm executive, and Centocor recruiter

Frank Baldino: Founder, chairman, and CEO of Cephalon (1987–present)

Paul Brock: Hubert's first hire at Corning Medical (1976–1979), Centocor researcher

Sister Mary Broderick: Head of the Rosemont School of the Holy Child, where Hubert's children attended school (1983–present)

Sarah Cabot: Centocor's technology licensing director (1986–1990)

Nancy Chang: Early biomedical researcher at Centocor (1981–1984) and director of research of the Molecular Biology Group at Centocor (1984–1986)

Morgan Check: Neighbor of Hubert Schoemaker whose ulcerative colitis was minimized through the use of Remicade (2000)

Pat D'Antonio: Maintenance employee at Centocor (1986–2004)

Michael Dougherty: Assistant controller and later treasurer, chief financial officer, and senior vice president at Centocor (1983–1993)

Patty Durachko: Hired early on as a temp at Centocor, currently working in the finance department (1981–present)

Stephen Evans-Freke: Former investment banker at PaineWebber, an early Centocor investor

Anthony (Tony) Evnin: Venture capitalist at Venrock, Centocor's first investor (1974–present) and Centocor director (1981–1999)

Sandy Faragalli: Hubert's administrative assistant at Centocor and later manager of Employee Programs (1981–1999)

Fred Faulkner: Anne Faulkner Schoemaker's brother

Jean Pierre (J. P.) Garnier: Former president of Pharmaceuticals, North America, SmithKline Beecham (1990–1995) and current CEO, GlaxoSmithKline (2000–present)

Robert Gallo: Former National Cancer Institute researcher who helped identify HIV and collaborated with Centocor to develop one of the first genetically engineered HIV diagnostic tests

Joanne Gillis-Donovan: President and CEO of Melmark (1997–present), the facility for people with disabilities where Hubert's daughter Maureen lives

Ray Heslip: Longtime shipping and warehouse employee at Centocor (1986–1999)

Tony Ho: Neuronyx's first chief research and development officer (1999–2003)

George Hobbs: Attorney at Centocor (1987–1999) and Neuronyx (1999–2003)

David Holveck: Hubert's longtime friend and coworker at Corning Medical (1975–1983) and Centocor (1983–1999)

Nancy Jamieson: Hubert's coworker at Corning Medical (1978–present)

Betty Kahn: Hubert's middle sister

Richard (Rick) Koenig: Head of media and investor relations at Centocor (1991–1993)

Hilary Koprowski: Head of Wistar Institute and cofounder of Centocor

Mirjam Lange: Hubert's eldest sister

Joseph Leive: Personal friend of Hubert and Anne Faulkner Schoemaker

Peter Maher: Hubert's friend and manager at AIM Packaging (1975–1985)

Jeff Mattis: Centocor's first technical employee, a biochemist who worked on the rabies and ovarian cancer diagnostics before becoming vice president of Pharmaceutical Development (1979–1998)

Richard McCloskey: Joined Centocor in 1990, vice president of Clinical Research (1992–1997) and vice president of Medical Research (1997–1999)

Robert McCord: Chairman of the Eastern Technology Council, which Hubert cofounded

Denise McGinn: Centocor Researcher, ReoPro development project manager, and longtime employee of Centocor (1983–1985, 1987–1999)

Ann McKenzie: Hubert's first wife (married 1972; separated 1989; divorced 1996)

Michael Melore: Head of Centocor's Human Resources department (1990–1999)

Warren "Pete" Musser: Entrepreneur, cofounder of the Eastern Technology Council

Don Noble: President and CEO of Rubbermaid (1959–1980), friend and business partner of Hubert's father

Stelios Papadopoulos: Former investment banker at PaineWebber, an early Centocor investor

Desiree Paping: Hubert's youngest sister

Peter Phillips: Hubert's neuro-oncologist (1994–2006)

Bruce Peacock: Chief financial officer at Centocor (1981–1992)

Orlando Rodriguez: Hubert's dorm-mate at Notre Dame

Jonathan Saruk: Anne Faulkner Schoemaker's son and Hubert Schoemaker's stepson

Bernie Schaffer: Philadelphia-based market analyst; Hubert's friend and longtime tennis and golf partner

Paul Schimmel: Hubert's Ph.D. supervisor at Massachusetts Institute of Technology

Anne Faulkner Schoemaker: Hubert's second wife (married 1996)

Annie Schoemaker: Hubert's third daughter

Erik Schoemaker: Hubert's first cousin

Katherine Schoemaker: Hubert's second daughter

Kathleen Schoemaker: Hubert's cousin-in-law

Matt Schoemaker: Hubert's son

Paul Schoemaker: Hubert's brother

Nelson Shanks: Renowned portraitist and Hubert's friend

Kevin Smith: Hubert's dorm-mate at Notre Dame

Ignat Solzhenitsyn: Music director and principal conductor of the Chamber Orchestra of Philadelphia (1994–present), Anne's piano teacher, and Hubert's friend

Pedro Tetteroo: Head of Cell Biology at Centocor's Leiden manufacturing facility (1987–1999)

Bishop Daniel Thomas: Hubert's priest at Our Lady of the Assumption in Strafford, Pennsylvania (2005–2006), now Auxiliary Bishop of Philadelphia

Paul Touhey: Purchasing agent and later senior vice president of Operations at Centocor Diagnostics (1985–1998), and president and chief operating officer following its sale to Fujirebio to become Fujirebio Diagnostics (1998–present)

Anna Tury: Hubert's housekeeper and caretaker in his last years

Jan Vilcek: Professor at New York University, co-inventor of Remicade, Centocor's most successful therapeutic

Stephen Webster: A former PaineWebber investment banker Hubert recruited to cofound Neuronyx (1999–2003), and later president and CEO (2003–2006)

Harlan Weisman: President of Research and Development, clinical cardiologist, and team leader for ReoPro development at Centocor (1990–1999)

Vincent Zurawski: Cofounder, chief scientific officer, senior vice president, and clinical researcher at Centocor (1979–1992)

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Hubert J. P. Schoemaker Public Memorial Service, Perelman Theater, The Kimmel Center for the Performing Arts, Philadelphia, PA, 6 January 2006.

All the interviews listed below were conducted between June 2006 and November 2007.

Interview by Jennifer Dionisio
Sarah Cabot

Interviews by Ted Everson
Pat D'Antonio
Jean Pierre (J. P.) Garnier
Nancy Jamieson
Peter Maher
Robert McCord
Ann McKenzie
Warren "Pete" Musser
Orlando Rodriguez
Paul Schoemaker
Kevin Smith
Ignat Solzhenitsyn
Bishop Daniel Thomas
Vincent Zurawski

Interviews by Ted Everson and Lara Marks
Frank Baldino
Stephen Evans-Freke
Anthony (Tony) Evnin
David Holveck
Richard (Rick) Koenig
Hilary Koprowski
Paul Touhey
Stephen Webster

Interviews conducted by Lara Marks
Lee Ahrensdorf
Paul Brock
Sister Mary Broderick
Morgan Check
Michael Dougherty
Patty Durachko, Sandy Faragalli, Ray Heslip (collective interview)
Robert Gallo
Joanne Gillis-Donovan
George Hobbs
Betty Kahn, Mirjam Lange, Desiree Paping (collective interview)
Joseph Leive
Jeff Mattis
Richard McCloskey
Denise McGinn
Michael Melore
Stelios Papadopoulos
Bruce Peacock
Peter Phillips
Jonathan Saruk
Bernie Schaffer
Anne Faulkner Schoemaker
Erik Schoemaker and Kathleen Schoemaker (collective interview)
Katherine Schoemaker, Annie Schoemaker, and Matt Schoemaker (collective interview)

Pedro Tetteroo
Anna Tury
Harlan Weisman
Jan Vilcek

Interview Notes for Interviews by Lara Marks (no transcript or recording available)
Nancy Chang
Fred Faulkner
Nelson Shanks