



# A SHORT HISTORY OF ELSEVIER

In Celebration of the

125th Anniversary of Elsevier

and the 425th Anniversary

of the House of Elzevir

425.125

# Scientists and healthcare professionals are more inclined to look forward than back, which perhaps explains why there are so few written accounts of Elsevier, in spite of the publishing company's long and successful history.

Whereas historians have recorded science and medicine's key moments of progress — from Galileo's celestial revelations to Fleming's discovery of penicillin to the recent identification of SARS as a Corona virus — few have taken the time to examine the role that publishers have played in the history of science.

Given that 2005 marks the 125th birthday of Elsevier and the 425th anniversary of the publishing house of Elzevir from which the modern company takes its name, the time seems right to redress that imbalance and reflect on the myriad ways in which Elsevier has played a role in the history of science over the last 125 years. In that time Elsevier has evolved from a small Dutch publishing house devoted to the promulgation of classical scholarship to an international multimedia publishing company that currently provides over 20,000 titles and products to science and healthcare communities worldwide.

Elsevier's history is one of a series of collaborations in the effort to advance science and health. The fruits of the collaboration between Elsevier and the eclectic group of scientific visionaries that it has published — ranging from Jules Verne to Stephen W. Hawking — are obvious. Less obvious, but no less important are the cumulative efforts of the men and women who have dedicated their lives to disseminating and using scientific and medical knowledge: the editors, the printers, the librarians, the nurses, the doctors, the engineers, the information specialists, and the business people who coordinate the effort. Last but not least, Elsevier has enjoyed a number of crucial relationships with other great science publishers — North Holland, Excerpta Medica, Pergamon, Mosby, W.B. Saunders, Churchill Livingstone and Academic

425·125  
YEARS OF PUBLISHING  
TRADITION | EXCELLENCE

We commemorate the founding of the House of Elzevir in 1580 and celebrate the establishment of the Elsevier company in 1880.

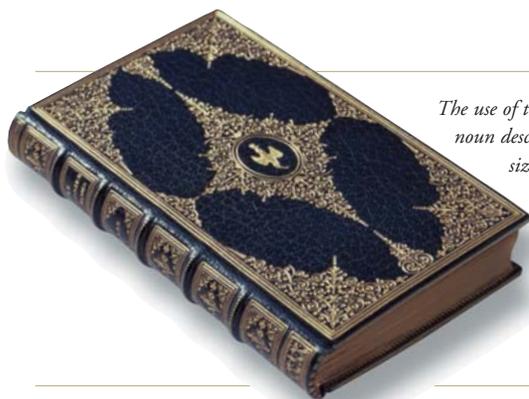
Press, to name but a few of the companies that are now part of the Elsevier family, bringing with them long and rich histories of their own. As the company moves forward into the new millennium, its founding motto seems more apt than ever: *Non Solus* (not alone).

## Founding Principles

It is ironic that Elsevier's founder, Jacobus Robbers, chose to name his small Dutch publishing company after a defunct seventeenth century publishing house. Nevertheless it makes sense: for in spite of the fact that the House of Elzevir had been out of business since 1712, the reputation of Elzevir publications had grown rather than declined by March of 1880 when the modern Elsevier was founded. At that time Robbers chose the modernized name Elsevier for his new company — simultaneously honoring the venerable tradition of the Elzevirs yet humbly differentiating his own endeavor — because he understood that old publishing name carried great cachet, both in and beyond the Netherlands. For by the late 19th century "Elzevirs" — small original reprints of the classics, scholarly books of diminutive proportions that could be carried in one's pocket — had become greatly prized and were avidly collected. These original "Elzevirs" had become valuable collector's items because the old House of Elzevir had produced such a superb body of work between 1580 and 1712, publishing a wide range of scholarly and important texts ranging from Virgil's *Opera Omnia* (1636) to Erasmus's edited version of the New Testament — known simply as *Textus Receptus* or "received text." (1663).

The original House of Elzevir was founded in 1580 in Leiden by Lowys (Louis) Elzevir, after William the Silent established the first Dutch university there in 1575. Entering what was already a competitive and risky business the Elzevir family (Lowys and six successive generations of sons, grandsons and nephews) ensured the success of their fledgling publishing house by developing a strong relationship with the new university, for whom they printed theses as well as reprints of classic texts. One Elzevir family member or another would serve as both "beadle" (the official who kept order on campus) and official printer from 1590 until 1712, when the last of the original Elzevir family publishers died, leaving behind no heir willing to continue the business.

The reputation of the Elzevir name did not die with the business however, as the Elzevirs left behind a considerable legacy of important books. Between 1580 and 1712 the House of Elzevir published an



The use of the word "Elzevir" as a noun describing a "pocket-book" sized collector's edition of the classics became quite commonplace in the educated parlance of the late nineteenth century.

Shown above, "Le Pâtissier François," printed in 1655 by Louis and Daniel Elzevir

estimated 2,000 to 3,000 titles, a significant achievement even by today's standards. During its tenure as a university press Elsevir published reprints of virtually all the major works of classical antiquity, including Aristotle, Terence, Cicero, Pliny and Horace. Elsevir also published new editions of Erasmus's *Colloquia*, along with Pierre Charon's *De La Sagesse*, Descartes' *Geometrica* and *Opera Philosophica*, and Milton's *De Pro Popula*.

This is not to say that Elsevir was an elitist press. The Elzevirs were sometimes obliged to publish popular titles — such as *The Grim and Bloody Siege of the City of Ostend in Flanders*, a thrilling true history, with the emphasis on the thrills — in order that they might subsidize other less profitable, yet more daring and scholarly, publications such as Galileo Galilei's *Discorsi e Dimostrazioni Matematiche, Intorno a Due Nuove Scienze* (Two New Sciences). The Elzevirs took both a personal and a financial risk in publishing *Two New Sciences* even after the work had been banned by the Inquisition in Italy and Galileo himself placed under house arrest. Galileo's last and greatest study, *Two New Sciences* is considered by many to be the first important work of modern physics, a groundbreaking treatise on the nature of motion and the strength of materials. The work was smuggled out of Italy to the Netherlands for publication by the Elzevirs in 1638. It was as a result of such risk-taking, as well as a reputation for printing excellence that the word "Elsevir" became symbolic of intellectual enterprise, albeit largely in scholarly circles.

Indeed, the use of the word "Elsevir" as a noun describing a "pocket-book" sized collector's edition of the classics became quite commonplace in the educated parlance of the late nineteenth century. There is ample evidence of this usage of the term in well-known works of nineteenth century fiction. In 1748, 30 years after the "House" went out of business, the fourth Earl of Chesterfield warned his 15-year-old son never to brag that he happened "to have an Elsevir classic" in his pocket. Fifty years later Victor Hugo used the term more loosely to describe collectors' books, as did the prolific popular author Mrs. Catherine Gore and the American novelist J.P. Kennedy, who wrote of going on "buying expeditions" to pick up "some famous Elzevirs." Additionally, at this time, according to *The Oxford English Dictionary*, the term "Elsevirian" also became popular as a reference not only to "one who collects or fancies the editions of the Elzevirs" but to bookish, perhaps even snobbish, antiquarian collectors.

The founder of the modern Elsevier publishing company was, one might suggest without insult, an "Elsevirian." A book lover rather than a businessman, Jacobus Robbers went into publishing intending, just like the original Elzevir family, to reproduce fine editions of literary classics for the edification of others who shared his passion, other "Elseverians."



*Galileo's last and greatest work, published in 1638 by Elzevir, Discorsi e Dimostrazioni Matematiche is considered the first important discussion of modern physics.*

Robbers even co-opted the Elzevir family's old printer's mark, visually stamping the new Elsevier products with a classic old symbol of the symbiotic relationship between publisher and scholar.

There is some debate over the meaning of the original Elzevir printer's mark that is still used as Elsevier's logo today and features an old man standing beneath a vine-entwined elm tree under which is



*The original Non Solus mark of Isaac Elzevir was used for the first time in Leyden in 1620.*

inscribed the Latin term *Non Solus* (not alone). The mark, first introduced by Isaac Elzevir (son of Lowys) in 1620, was featured on all Elzevir works from that time forth. That the Elzevir family took pride in their mark is undisputed; what they intended it to mean is less clear. Although most scholars agree that the elm represents the tree of knowledge, they cannot agree on the meaning of the intertwined vine. The Parisian

librarian Adry posited in 1806 that the elm tree entwined with the grapevine symbolized the bond between brothers Isaac and Abraham Elzevir and that the old man, a hermit, symbolized the seclusion of study. However, contemporary art historian Lucy Schlüter suggests more persuasively that the old man represents a wise scholar, a philosopher — evoking Erasmus' image of Socrates sitting under a tree in a rural setting delivering fruitful and inspiring lectures.

In this context the intertwined tree and vine represent a fruitful relationship — and the story therefore carries a moral. As Erasmus said, referring to the classic metaphor of tree and vine:

*"Like the vine which, though the most distinguished of all trees, yet needs the support of canes or stake or other trees which bear no fruit, the powerful and the learned need the help of lesser men."*<sup>1</sup>

Viewed this way, the logo represents, in classical symbolism, the symbiotic relationship between publisher and scholar. The addition of the *Non Solus* inscription reinforces the message that publishers, like the elm tree, are needed to provide sturdy support for scholars, just as surely as scholars, the vine, are needed to produce fruit. Publishers and scholars cannot do it alone. They need each other. This remains as apt a representation of the relationship between Elsevier and its authors today — neither dependent, nor independent, but interdependent.

Although the modern Elsevier company cannot in any way take credit for the achievements of the seventeenth century Elzevirs, or even lay claim to the creation of the Elsevier printer's mark, it is fair to say that the company was founded upon an idealistic vision of continuing the original publisher's honored traditions. The adoption of both the Elzevir name and printer's mark was deliberate — a gesture of respect for the past as well as a promise that the name Elsevier would always be synonymous with excellence.

[1] Erasmus, *A Complaint of Peace* (translated and annotated by Betty Radice) in *Collected Works of Erasmus*, Vol. 27 (Toronto, 1986) p.294, and quoted in *Lucy Schlüter and Pierre Vinken, The Elsevier Non Solus Imprint* (Elsevier 1997), p. 20.

MANY SIGNIFICANT SCIENTIFIC, TECHNICAL AND MEDICAL BREAKTHROUGHS HAVE APPEARED IN OUR PUBLICATIONS, AFFECTING THE PATH OF HUMAN DEVELOPMENT ITSELF.

- 2004** New research in *Archives of Oral Biology* by Finnish scientists demonstrated that smoking depletes calcium stores in the bones, and a simple salivary test can prove it.
- 2002** Sydney Brenner and Robert Horvitz won the 2002 Nobel Prize in Medicine for their work on genetic regulation of organ development and programmed cell death. Horvitz's first and seminal paper identifying two cell-death genes was published in *Cell* in 1986. Brenner, Editor of the Academic Press flagship title, *Journal of Molecular Biology* in the 1980s, recently edited *Encyclopedia of Genetics*, published under the Academic Press imprint.
- 2000** Eric Kandel won the Nobel Prize in 2000 for his work on mechanisms of learning and memory in *Aplysia* much of which was published in *Cell* and *Neuron*.
- 1997** Dr. Stanley Prusiner won the 1997 Nobel Prize for his work on prions and self-replicating proteins as a mechanism of disease transmission. His early work was published by *Cell* in the face of much controversy. Dr. Prusiner is also co-editor of *The Molecular and Genetic Basis of Neurological Disease*, published under the imprint of Butterworth-Heinemann.
- 1996** The first reported disclosure on Viagra™ and its utility for the treatment of male erectile dysfunction was published in *Bioorganic & Medicinal Chemistry Letters*, Vol. 6, pp. 1819-1824 (1996).
- 1993** Published in 10 volumes in 1993, *The Encyclopedia of Language and Linguistics* was hailed as the most comprehensive and ambitious work of its kind ever produced.
- 1981** Mosby nursing author Donna Wong, Ph.D., RN, PNP, CPN, FAAN, developed the FACES Pain Rating Scale, which is used throughout the world to assess the pain of children.
- 1972** The article "Expectations and the Neutrality of Money" in the *Journal of Economic Theory*, Vol. 4, no. 2, (1972) earned the author, Robert E. Lucas, a Nobel Prize.
- 1969** Egan's *Fundamentals of Respiratory Care* has been credited with initiating the educational growth of the respiratory care profession. First published in 1969 under the title *Fundamentals of Inhalation Therapy* by Donald F. Egan, the book endures as the most widely used and respected resource in respiratory care.
- 1946** In 1946 Butterworth published a book, edited by Sir Alexander Fleming, about a revolutionary new antibiotic, *Penicillin: Its Practical Application*.
- 1940** *The Lancet* published the first article on the revolutionary antibiotic effects of penicillin in mice.
- 1939** Peter Drucker's book *Management: Tasks, Responsibilities, Practices* was included in the list of 100 books that shaped the twentieth century. Peter Drucker has published with Heinemann, now Elsevier since 1939, an unprecedented 66-year relationship.
- 1937** "The Sources of Atmospheric Pollution" in *Fuel in Science and Practice*, Vol. 15, pp. 221-228 (1937) by R. Lessing provided early insight into the continuing debate about the impact of the combustion of fossil fuels on the environment.
- 1923** The publication of Le Corbusier's *Towards a New Architecture*, Architectural Press, in 1923 was a major contribution to the development of modern architectural thinking.
- 1858** The publication of *Gray's Anatomy* in 1858 was a landmark for the study of the human anatomy and in many ways for the whole of medicine.

### Before Science: Elsevier in the Early Years (1880-1933)

In the early years, the aims of the Elsevier company were relatively simple: publish good quality editions of literary and scholarly classics and stay in business while doing so. For the next 50 years four successive generations of sons and grandsons did just that. They kept things relatively simple — a wise move for a publishing company that did not employ more than 10 people until the 1940s. This is not to say that during these years the company did not move forward. By 1887, just seven years after its founding, Elsevier's operations had moved from Rotterdam to the publishing center of Amsterdam. With that move came the company's first success — obtaining the Dutch rights to Jules Verne's *Illustrated Travels* (in 57 volumes).

Publication of Verne's *Travels* was followed by the launch of the *A.J. Prins Illustrated Encyclopedia*, and it was this endeavor that best represented the ongoing focus of the new Elsevier. Over the next 40

years Elsevier would slowly develop a specialty in publishing encyclopedias that would ultimately change the company's direction. By the 1930s, the company was far more focused on the publication of textbooks, science handbooks, and encyclopedias than the reproduction of literary classics. In spite of its growing reputation for publishing excellent scholarly titles however, the company was constantly overdrawn at the bank and struggling to support its handful of employees. It was only after the end of WWII, when Elsevier began to seriously immerse itself in the business of international scientific publication, that the company got on to a sound financial footing and began the journey toward becoming the world's largest scientific, technical and medical (STM) publisher.

### Science Without Boundaries: 1933-1956

In the 1930s German was still considered the primary language of international scientific communications — because German scientists held the leading position in many disciplines, including chemistry,

mathematics and physics. German was also the language of scientific publication in Vienna, then the reputed center of medicine, psychology and psychiatry, as well as in Czechoslovakia, Poland, Scandinavia and the Netherlands. Even in English-speaking countries such as the U.K. and the U.S., scientists were expected to read German to keep up with developments in their fields.

However, after the National Socialist Party came to power in 1933, Germany lost many of its greatest scientists in the exodus from Hitler's anti-Semitic and anti-intellectual regime. As Hitler's repressive regime gained strength the Netherlands increasingly provided a haven for scientists and intellectuals fleeing Nazi Germany. The closer war loomed, the more scientists flooded into Amsterdam, The Hague and Rotterdam, either looking for refuge or passage to freedom in the U.S., making the Netherlands a new locus of scientific thought and publication.

Sensing that the exodus of all these scientists would reshape the intellectual landscape Elsevier anticipated a change in the scientific community and a corresponding need for English-language scientific texts, a prediction that would prove the making of the company. Although the language of science remained German, Elsevier predicted that there would be a growing demand for those texts to be translated into English, for both political and practical reasons. Although the U.K. and the U.S. already published their own scientific findings in English, that work was done by the scientific societies, smaller scale publishers who favored local authors and printers. Nobody was publishing the work of European scientists in English. Elsevier saw an opportunity to fill that gap. One of the first textbooks they published, in 1937, was chemist Paul Karrer's *Organic Chemistry*, an English translation of the highly successful textbook *Lehrbuch der Organischen Chemie*. Later that year Karrer was awarded the Nobel Prize for his investigations on carotenoids, flavins and vitamins A and B2. Thus even though the company's first science-publishing endeavor was not a commercial success, it did establish Elsevier's reputation as a specialist publisher of English-language science texts.

As the new business grew, the company eagerly made plans to publish another English-text science publication — the Elsevier *Encyclopedia of Organic Chemistry* — that would bring together the work of various international scientists. The company also began to expand internationally, establishing a U.K. office in 1939, and planning to follow that with the establishment of a U.S. subsidiary. These efforts were not to come to fruition for another 20 years.

All plans were brought to a sudden halt on May 10, 1940, when the Nazis crossed the Dutch border. Activities in the Netherlands came to a standstill during the war. Although Elsevier continued to make preparations for future publications, the company was not allowed to publish the works of any authors who were not registered with the "Kultuur Kamer," severely limiting the scope of academic publishing in the Netherlands. Worse still, those German refugees who had played such a major role in the development of Dutch international publishing were suddenly in danger. Some went into

1934

*Richter Anschutz's The Chemistry of the Carbon Compound, translated and published by Elsevier in 1934, introduced Archibald Scott Cooper's discovery that carbon had a valency of four and that its atoms could self-link to form chains — a fundamental breakthrough that launched organic chemistry.*

hiding and escaped death, or fled to the U.S. Two Elsevier employees, Dr. Maurits Dekker and Dr. Eric Proskauer made their way to the US. Although, as a result of legal issues, they never established the Elsevier subsidiary that had been planned, they did found Interscience, a successful company that would later partner with Elsevier to co-produce journals. Others were not as fortunate as Dekker and Proskauer, and many scientists and editors were either deported from the Netherlands or killed during the war years.

After the war German universities and German scientific research were slow to recover and the "brain drain" continued as significant numbers of West German scientists left for the U.S. and other western countries. The intellectual landscape had changed, with its center of gravity shifting from Germany to the mid-Atlantic. Elsevier, already an international publisher, was well-positioned to continue serving the expanding international market. Not only was it culturally prepared for the changing landscape of the scientific community, it was physically well-placed between the European continent and the English-speaking countries. The Netherlands then, with its history of scientific publishing, its ideal geographic position and its reputation for multilingual fluency, was the perfect base for the new world of international science publishing. Grabbing the moment, Elsevier set forth to become an innovative international science publishing company.

Elsevier began by rapidly building a strong book program. When that proved successful, the company ventured into new territory, the world of international science journals. In 1947, Elsevier introduced the first international journal in the field of biochemistry and biophysics — *Biochimica et Biophysica Acta (BBA)*. The journal was published in cooperation with Elsevier's old friends at Interscience and was run by a neutral board of international editors. Even though it was not to turn a profit until 1951 (and even then the profit was modest)

*Biochimica et Biophysica Acta* was a truly cooperative and international enterprise, one that set the model for all future Elsevier journals. *BBA* was also visionary — understanding from its inception that genetic research would ultimately become the issue of the century for biochemists.

Indeed *BBA* has continued to herald advances in genetic research. As a result of more than 50 years of publishing groundbreaking work *BBA* is today not only the oldest, but indubitably among the most esteemed, of all Elsevier titles.

Indeed *BBA* continues to rank among the top 20 most cited of all science journals.



*BBA was also visionary — understanding from its inception that genetic research would ultimately become the issue of the century for biochemists.*

425.125

However, back in 1947 if those involved in putting out the innovative new international journal expected accolades and congratulations, then they must have been sorely disappointed. For in fact the international journal model, as represented by *Biochimica et Biophysica Acta*, encountered fierce opposition. Some scientists argued that the growing subdivision of science into smaller specialties (instead of adhering to the old linguistic and geographical boundaries) would weaken science by reducing the range of individual scientists' knowledge. The editors of various European national journals complained that the growth of international publishing would lead to a shortage of publishable manuscripts for local journals. In the early days this opposition was fierce enough and powerful enough to thwart some international science publishing endeavors. Indeed in the 1950s another Dutch international science publisher, North Holland (a company whose destiny was to become intertwined with Elsevier's) failed in its attempts to establish a European journal of nuclear physics because of such resistance.

In spite of this opposition however, slowly but surely over the course of the 1950s, both Elsevier and North Holland began to develop an impressive collection of science journals including: *Analytica Chimica Acta* (Elsevier 1947), *Clinica Chimica Acta* (Elsevier 1956), *Wear* (Elsevier 1957), *Chromatography* (Elsevier 1958), *Physics Letters* (North Holland 1967) and *Nuclear Physics* (North Holland 1956), the journal that published Gerardus 't Hooft and Martinus J.G. Veltman's Nobel Prize-winning papers on particle physics theory. By the 1960s then, the business of international science publishing was taking off and the Dutch were leading the way. Having developed a significant list of reputable international peer-review journals, Elsevier set out to expand internationally, opening a branch of the company in the U.K. in 1961, followed by the creation of a marketing, distribution and publishing center in New York in 1962. Elsevier was finally on its way to creating the global scientific publishing company originally envisaged back in the 1930s, before Hitler destroyed so much of the intellectual fabric of European society.

### Diversification and Expansion: The 1970s and 1980s

In the late 1960s, things stopped going quite so well, not only for Elsevier, but for all scholarly Dutch publishers. An unfortunate confluence of events conspired to create a crisis for the Dutch publishing industry. The trouble began in the late 1960s when everywhere in the world, starting in the U.S., universities ceased expanding, reducing the rate of growth in the demand for scholarly publications. At the same time, labor costs in the Netherlands rose precipitously and once-inexpensive books and journals from Holland became costly. In response to the rising cost of books and journals, libraries expanded their interlibrary loan (ILL) programs as a way to compensate for their inability to purchase complete inventories of scholarly titles. These expanded ILL programs were facilitated by the phenomenon of photocopying, making Xerox® a surprise new factor in an already tight market.

Thus by the beginning of the 1970s, older expectations of the continuous expansion of Dutch international journal production were

### 1951 & 1956

*The 1951 article: "Studies on the structure of ribonucleic acids" (BBA 7:396-412) by Boris Magasanik and Erwin Chargaff spurred the research that led up to the discovery of the DNA structure. Similarly, following the discovery of the double helix: "Enzymic synthesis of deoxyribonucleic acid", by Arthur Kornberg et al. (BBA 21:197-198), published in 1956, was the first to report the isolation of the enzyme DNA polymerase, a finding fundamental to polymerase chain reaction, which has implications for every lab conducting analysis and engineering of genes and chromosomes.*

significantly curtailed — and as a result the viability of newer journals was threatened. Whereas in the early 1960s a journal could break even in three to five years, by the mid-70s, a maturation period of seven to eight years became more normal. The prognosis for the future growth of the companies that published these scholarly journals was not as good as it had seemed a decade earlier. Responding to the industry-wide crisis, a number of scientific publishing companies joined forces, choosing to pool resources rather than continue running expensive individual operations. Thus began a decade of mergers for Elsevier.

The first came in 1970 when Elsevier and North Holland merged, a natural partnering of two friendly and complementary businesses. Next, in 1971, came a merger with Excerpta Medica an old and innovative medical abstracts company. Excerpta Medica, an international medical publishing company in business since the 1940s, was currently in the process of creating an electronic database that would contain abstracts of all medical literature published in all languages. That database, born of neurosurgeon-turned-publisher Pierre Vinken's personal notes, was ultimately to become EMBASE, a product which Elsevier launched in 1972 in its first venture into the field of information technology. The work of Excerpta Medica was a good fit with the work of Elsevier and North Holland, and as the newly named Associated Scientific Publishers, the three merged companies set out to be the premier provider of international science and medical information.

The most significant expansion effected by the newly merged science group occurred in the U.S., where a large-scale foray into clinical medical publishing put the company on the map in American medical publishing, expanding the scope of the business as a whole. In the late 1970s Elsevier won its first contracts for large medical society journals, including the journal *Gastroenterology*, the most highly cited journal in the field of gastroenterology and hepatology. The production of such journals represented a significant shift of scale for Elsevier, as well as a change in market. Whereas previously the company's largest journals — such as *Artificial Intelligence*, *Brain Research* and *Nuclear Physics* — had circulations of approximately 1,500-2,000, the company's new medical society journals had circulations ranging from 15,000 to almost 30,000, representing a sizeable change in the scale of production for Elsevier. Furthermore, these large-scale journals sold advertising space to pharmaceutical companies, a new working challenge for Elsevier but also a new source of revenue. Taking on such challenges built interna-

tional recognition for the Elsevier name in the world of clinical medicine.

The success of the clinical medical publishing venture encouraged further confident expansion and a new emphasis on volume growth that made for heady times at the growing company. Throughout the decade, the company would expand in multiple directions, establishing its presence in many new geographic as well as publishing arenas. For example, in 1984, Elsevier established its French office in Paris, having successfully negotiated the rights to publish the journals of the renowned Institut Pasteur. Today, the French division of the company is best known for its publication of the *Encyclopédie Médico-Chirurgicale*, a familiar multi-volume series that is subscribed to by almost half of France's 200,000 French doctors and specialists, and that can be seen in the background of many French films and TV series featuring doctors' offices.

The optimism of early 1980s expansion was also reflected in the company's willingness to fund experimentation. During this period, the company developed a "let a thousand flowers bloom" policy, encouraging many small exploratory electronic projects in the hope that out of all that experimentation would come some real, useable, innovation. The "let a thousand flowers bloom" policy reflected the exploratory and scientific bent of Elsevier's core personality and would ultimately prove very successful — even if most of the ideas did not bloom immediately.

Given the scientific background of so many Elsevier staff, there was, not surprisingly, an early awareness of developing information technology and a strong sense of its importance. The company was quick to imagine the promise such technology held for the publishing business. As early as 1979, responding to the need for an article delivery system that could compete with Xerox and interlibrary programs, Elsevier brought together a group of publishers for an exciting and novel electronic journal distribution project — Adonis. Adonis was the company's first attempt to deliver documents, via new technology, faster and less expensively than anyone else. Adonis was to be the information delivery system of the 1980s and science publishing's greatest new innovation. Unfortunately, the idea didn't work as well in practice as in theory. The earliest technology developed by the Adonis project proved far more expensive than prevailing manual document delivery systems — and too expensive for customers. When finally, almost a decade later, the cheaper alternative of CD-ROMs for PCs became available, the Adonis project was reinvigorated. Unfortunately however, the impracticality of long runs of journals on CD-ROMs also proved to be commercially unattractive, and the ambitious and expensive Adonis project was finally abandoned. In spite of the project's ultimate failure, however, the early IT experiments it initiated (along with those developed by others) would eventually evolve into the systems used today on personal computers, proving that the investment was well worth it in the end.

Nobody knew this at the time, however. The investment in new technologies proved frustratingly slow to yield results and by the end of the 1980s, Elsevier had little to show its customers for a decade of work on information delivery systems. Worse still, the company was facing a

1991

*Namba et al published a groundbreaking paper in Brain Research, "Apolipoprotein E immunoreactivity in cerebral amyloid deposits and neurofibrillary tangles in Alzheimer's disease and kuru plaque amyloid in Creutzfeldt-Jakob disease." (Brain Research 541:163-6). The article describes their research where they unexpectedly identified the antibody "apoE" as being implicated in both Alzheimer's and Creutzfeldt-Jakob disease. Research spawning from this highly cited paper has been ongoing and has tremendously improved scientists understanding of Alzheimer's disease.*

public relations crisis in the U.S. as a result of the fluctuating exchange rate. As the U.S. dollar lost ground against the Dutch guilder, the cost of Elsevier's international journals to its U.S. clients rose. Pricing journals in the currency of the country of publication (Dutch guilders, U.K. and Irish pounds, Swiss francs, etc.) meant that the customer bore the risk of

**Today, the French division of Elsevier is best known for its publication of the *Encyclopédie Médico-Chirurgicale*, subscribed to by almost half of France's 200,000 French doctors and specialists (and seen in the background of many French films and TV series featuring doctors' offices).**

exchange rate fluctuation, and the fluctuations were great from year to year. This situation was ultimately remedied when the company began pricing in the local currency of its three major customer groups (U.S. dollars, euros and yen). Until such remedies were instituted, however, librarians blamed the company for their rising purchase costs, a problem that was compounded by the tightening of library budgets. This tension with science publishing's greatest ally, the librarian, was a demoralizing new phenomenon for the company. As the company moved forward into the 90s then, it faced some key new issues

— namely how to best serve customers and librarians in times of strained library budgets and rapid technological change.

## The Revolution: Charting a Course From the 1990s to the New Millennium

Elsevier wasn't the only publishing company that struggled in the precarious years of the late 1980s. Robert Maxwell's media empire began to crumble at the end of the decade. Maxwell, who had once attempted a hostile takeover of Elsevier, now approached the company, hoping to sell Pergamon — the jewel in the crown. Pergamon, founded in 1948 and incorporated as Pergamon Press in 1951, was a company that specialized in founding new journals in emerging areas of science, filling a need to respond to the rapid development of scholarly sub-disciplines that was not being addressed by the academic societies. Pergamon's 400 titles would make a superb addition to Elsevier's collection. Although the company produced many prestigious journals, its most famous were *Tetrahedron* and *Tetrahedron Letters*. Those journals were co-founded by Robert Burns Woodward, a chemist who published his 1965 Nobel-Prize-winning work on the synthesis of strychnine and reserpine in *Tetrahedron*. Pergamon also published *Acta Metallurgica* (now titled *Acta Materiala*) and major reference

works such as *The International Encyclopedia of Education* and *The Encyclopedia of Material Science and Engineering*. The addition of such titles promised not only to enhance and expand the range of Elsevier's list (adding a significant social science program) but also to round out the international component of the business, giving the company a large British presence. The £440 million sale was finalized in 1991, a promising start to the new decade.

Acquiring the prestigious English medical journal *The Lancet* later that same year just put the icing on the cake. *The Lancet*, which had been founded in 1823 by the radical independent physician Thomas Wakely and retained his spirit of independence, had been at the leading edge of medicine for over 160 years, breaking stories from the discovery of penicillin in 1940 to HIV transmission in 1984. Acquiring *The Lancet* would help put Elsevier at the head of the field of medical publishing as well as scientific publishing.

No sooner, it seemed, had Elsevier completed its own merger with Pergamon and acquired *The Lancet* than the Elsevier NV parent company began negotiations with Reed, a papermaking company turned media conglomerate with interests ranging from women's magazine publishing to trade printing to old-fashioned papermaking. The 1993 Reed merger brought new strength to Elsevier Science Publishers through the addition of the titles of Butterworth-Heinemann, publisher of the so-called "Four American Journals." These four titles — *The American Journal of Cardiology*, *The American Journal of Surgery*, *The American Journal of Medicine*, and, incongruously, *Urology* — are all large-circulation subscription journals for medical practitioners. Their addition added breadth to Elsevier's growing healthcare publications. The Reed Elsevier merger was not all about titles however, and with it came the predictable challenges of large-scale operational change.

Although there had been much talk of integration and restructuring over the previous few years, the Reed merger clearly created an imperative for action. Thus, in the early 1990s, Elsevier management implemented a deliberate new policy of globalization. First they implemented a single organizational structure within the company. Previously, Elsevier had been a federalist entity, with its divisions separated by geographic boundaries, a structure that caused unnecessary overlap. Now the company was to be reorganized along product lines, grouping together like products and staff in a way that reflected the lack of international barriers in science itself. Next, Elsevier implemented a new international editorial structure — designed to bring together and strengthen the company's considerable, yet geographically dispersed, editorial resources. An international editorial structure encouraged new cooperative editorial boards to not only share resources but to combine knowledge and expertise.

***It would be the technological revolution that Elsevier experienced at the end of the 1990s that gave everyone in the company the opportunity to share a genuine historic moment.***



The Lancet, founded in 1823 by the radical independent physician Thomas Wakely



The development team from Elsevier's TULIP project (1991-1995), the largest experiment of its kind at the time in electronic journal distribution

Although the new organizational and editorial structures helped the company achieve a sense of global identity, there was still a need for the newly expanded company to realize a shared identity, a shared history. This took a little more time. It would be the technological revolution that the company experienced at the end of the 1990s that gave everyone in the company the opportunity to share a genuine historic moment — the successful launch of electronic science publishing — what M. Stuart Lynn has described as "the second Gutenberg Revolution."<sup>2</sup>

From the very beginning of the 1990s (and earlier) the company had been aware of a pressing need to develop electronic systems and services to revolutionize the way Elsevier delivered information. From 1991 to 1995 Elsevier conducted what even competitors would agree was the largest experiment of its kind in this period, the TULIP project. TULIP was an experimental university licensing program that tested new methods of electronic journal distribution over local university networks. The program began by delivering 42 Elsevier and Pergamon journals in materials science and engineering — about 2,000 pages weekly — to nine American universities (16 counting all eight campuses of the University of California) and grew to over 80 journals by the final year. The system was both important and impressive, but not without its

teething problems. Although TULIP did distribute the information as promised, this experiment started in the pre-web browser era, and therefore each university had to develop its own implementation for the locally hosted files, a task that proved to be a great challenge for some partners. Nevertheless the program was an extraordinary innovation, one that would lead straight to a commercial offering of all journals for local hosting (Elsevier Electronic Subscriptions) and then to the hugely successful ScienceDirect®.

In 1997, after almost two decades of experimentation with information technology, Elsevier launched ScienceDirect, a web-accessible online full-text database of Elsevier's entire STM journal collection. ScienceDirect marked a revolution in the way scientists accessed, retrieved and shared information around the world. Selling this new service called for the creation of an international network of regional sales offices (including the expansion of the Asia Pacific office), another major investment in building sophisticated new expertise. The company's digital revolution created other new challenges, not least of which was the question of how to preserve digital information indefinitely while still ensuring easy access, regardless of the changing nature of technology.

[1] M. Stuart Lynn of Cornell Information Technology, quoted in *ESP World* (Aug/Sep 1993), p.13.

1990

One of the many groundbreaking articles published in *Tetrahedron* is the 1990 article "Total synthesis of the L-hexoses" (46: 245-264) by Ko et al., an exceptional demonstration of the powers of asymmetric synthesis. These breakthrough chemical synthesis pathways were discovered and developed through the 1980s and opened up vast new avenues for chemical reaction research, and drugs and material development. The research area proved so promising that in 1990 Pergamon launched the journal *Tetrahedron: Asymmetry*. One of the paper's authors, K. Barry Sharpless, later was awarded the Nobel Prize in 2001 for his work on chirally catalyzed oxidation reactions.

In a first step towards the creation of a complete archive of a unified collection of Elsevier publications, in 2002 the company embarked on a digital preservation project with Koninklijke Bibliotheek (KB), the National Library of the Netherlands. Elsevier provided the library with digital copies of its entire ScienceDirect journal collection (including backfiles of *The Lancet* dating back 180 years and backfiles of all of its journals back to volume 1, number 1, the result of a \$40 million investment Elsevier made to capture its entire journal heritage in digital form). In turn, Koninklijke Bibliotheek created the first independent digital archive of Elsevier's publishing history. Realizing the significance of the KB collaboration, today Elsevier has continued to explore archiving initiatives with other institutions around the world, in an ongoing effort to ensure maximum protection for the archive.

These archival projects are on a scale never before imagined, as by the year of its anniversary — 2005 — Elsevier has grown into the largest STM publishing company, producing more than 1,800 journals and almost 3,000 new books each year. Part of the company's growth came through the traditional acquisition of unique companies that added breadth and depth to the Elsevier range of products, such as MDL (Molecular Designs Limited), a software development company serving the pharmaceutical, agrochemical and biotechnology industries; Engineering Information, an electronic engineering information distribution company, home to Engineering Village 2™; and Cell Press, publisher of the prestigious journal *Cell*. Founded in 1974 as "a journal of exciting biology" by Dr. Benjamin Lewin, *Cell* is notable for publishing such Nobel Prize-winning breakthroughs as Infectious Prion Proteins and Olfactory Receptor Cloning. The acquisition of such properties clearly enhanced both Elsevier's collection of titles and products as well as its reputation.

However, the company's most dramatic growth at the start of the new millennium was achieved, of course, after Harcourt put itself up for sale and most of it was acquired by Reed Elsevier, including an educa-

tional publishing group that became a fourth piece in the Reed Elsevier collection (along with Elsevier in science and medicine, LexisNexis in law and Reed Business in trade magazines and exhibitions). Harcourt brought with it a long and rich medical publishing heritage courtesy of imprints like Mosby, Saunders and Churchill Livingstone. To name but a few of their publishing achievements, those three companies between them have produced *The Harriet Lane Handbook*, *Total Patient Care*, the original *Gray's Anatomy*, *Dorland's Medical Dictionary*, *The Cecil Textbook of Medicine*, *Noyes Modern Clinical Psychiatry*, *Mosby's Medical Nursing and Allied Health Dictionary*, *Robbins & Cotran's*

**The Kinsey Report would prove the company's willingness to push the boundaries of social norms to advance scientific knowledge.**

*Pathologic Basis of Disease*, and *Miller's Anatomy of the Dog*, a text which originally made W.B. Saunders America's leading veterinary publisher. Additionally, in the Harcourt purchase Elsevier acquired MD Consult, a unique electronic reference service for doctors and healthcare providers, used widely in American medical schools and hospitals. Soon after, in May 2002,

Elsevier further added to its offerings for medical practitioners with the acquisition of Hanley & Belfus, Inc., a Philadelphia-based publisher founded in 1984 by John Hanley and Linda Belfus (former W.B. Saunders executives). Hanley & Belfus produces texts for medical students that are renowned for being reader-friendly: its *Secrets Series* offers an innovative interactive approach to medical textbook publishing.

Although the list of titles and products added to the Elsevier collection via the process of mergers and acquisitions is impressive, no list can convey the richness of the publishing history that accompanies those titles and products. When Elsevier acquired W.B. Saunders — founded by Walter Burns Saunders in 1888 in Philadelphia — in the Harcourt purchase it also acquired a special piece of American history: the story of *The Kinsey Report*. That story mirrors the history of science as well as science publishing: risky, unpredictable, daring and potent with intellectual reward. In the 1930s Alfred Kinsey had conducted in-depth interview-based research on sexual behavior, determined to redress a yawning gap in the scientific record. Anticipating the interest of a small audience of psychiatrists and other professionals, the publisher Lawrence Saunders authorized a small first printing (25,000 copies) of what he considered a limited-audience medical book. To his surprise, upon its release in 1948 *The Kinsey Report* sold out within two days, in spite of opposition from conservative political and religious groups, because it offered Americans the first publicly available, frank and scientific discussion of sex. *The Kinsey Report*, which took a daring step away from the traditional medical textbook collection of Saunders, would prove the company's willingness to push the boundaries of social norms to advance scientific knowledge.

Indeed all the companies acquired by Elsevier in the Harcourt



*Cell* is notable for publishing such Nobel Prize-winning breakthroughs as Infectious Prion Proteins and Olfactory Receptor Cloning.

THE MAJORITY OF NOBEL LAUREATES HAVE PUBLISHED  
WITH ELSEVIER OVER THE LAST 50 YEARS

**E**ighty eight percent of Physics laureates, 95% of Chemistry laureates and 56% of Physiology or Medicine laureates, over the last 50 years, and 76% of Economics laureates since the award's inception in 1969 have published with Elsevier. And, all of the 2004 winners in Chemistry, Economics, Physiology or Medicine and Physics have published with Elsevier:

**THE 2004 NOBEL PRIZE IN CHEMISTRY** — “for the discovery of ubiquitin-mediated protein degradation”

- **Avram Hershko**, Technion, Israel Institute of Technology, Haifa, Israel
- **Irwin Rose**, University of California, Irvine, CA, USA
- **Aaron Ciechanover**, Technion, Israel Institute of Technology, Haifa, Israel

**THE 2004 BANK OF SWEDEN PRIZE IN ECONOMIC SCIENCES IN MEMORY OF ALFRED NOBEL** — “for their contributions to dynamic macroeconomics: the time consistency of economic policy and the driving forces behind business cycles”

- **Finn E. Kydland**, Carnegie-Mellon University, Pittsburgh, PA, USA; University of California, Santa Barbara, CA, USA
- **Edward C. Prescott**, Arizona State University, Tempe, AZ, USA; Federal Reserve Bank of Minneapolis, Minneapolis, MN, USA

**THE 2004 NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE** — “for their discoveries of odorant receptors and the organization of the olfactory system”

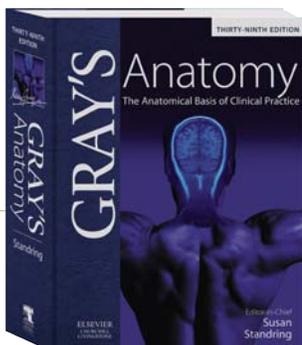
- **Linda B. Buck**, Fred Hutchinson Cancer Research Center, Seattle, WA, USA; Howard Hughes Medical Institute, Chevy Chase, MD, USA
- **Richard Axel**, Columbia University, New York, NY, USA; Howard Hughes Medical Institute, Chevy Chase, MD, USA

**THE 2004 NOBEL PRIZE IN PHYSICS** — “for the discovery of asymptotic freedom in the theory of the strong interaction”

- **Frank Wilczek**, Massachusetts Institute of Technology, Cambridge, MA, USA
- **H. David Politzer**, California Institute of Technology, Pasadena, CA, USA
- **David J. Gross**, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, CA, USA

acquisition brought something special to the Elsevier collection. Academic Press, a company started in the U.S. in 1942 by two European science publishers, Walter Johnson and Kurt Jacoby, who had fled the Nazis, brought with it a tradition of intellectual rigor that paralleled that of Elsevier. The company's most important title, *Virology*, was edited for many years by another refugee from war-torn Europe, the Italian

Salvador Luria who was awarded the Nobel Prize in Medicine in 1969 for his discovery of the replication mechanism and genetic structure of viruses.

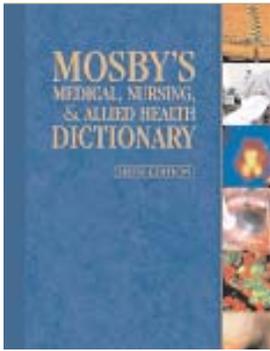


*U.S. novelist Sinclair Lewis declared in 1925 that only three books were essential to a doctor's education: Shakespeare, the Bible and Gray's Anatomy.*

The Harcourt acquisition also added the titles of Churchill Livingstone, a medical publishing company originally established in London as J&A Churchill in 1728, that boasted a list of medical books dating back to 1688. The most famous of all Churchill Livingstone publications is *Gray's Anatomy*. Up until the mid-nineteenth century the

study of anatomy was limited to the dissection rooms of teaching hospitals and pocket-sized textbooks with tiny illustrations. Hoping to create a useful tool for the medical students he taught at St. George's Hospital in London, Dr. Gray wrote a new text that was simultaneously more detailed, clear and confident than existing texts. He then recruited his friend Henry Carter to provide large and highly detailed illustrations. The result, first published in 1858, was the first edition of what would become one of the best-selling medical books of all times. Today in its 39th edition, and now available electronically as well as in print, *Gray's Anatomy* continues to innovate with its descriptions of radiological anatomy and new microanatomy images.

Whereas Saunders and Churchill Livingstone catered largely to the medical profession and Academic Press focused on science, two areas in which Elsevier had been interested for some time, the Mosby imprint brought a whole new collection to the expanded company: texts for nurses and allied health practitioners. The C.V. Mosby Company was founded by medical practitioner Charles Virgil Mosby, who was part humanitarian, part visionary, part entrepreneur. Combining his desire to serve people with a notion to sell books, in 1906 Mosby began a publishing company dedicated to serving practitioners. He started with medical books, then moved on to the dental field, before publishing his first nursing book in 1917, addressing a pressing war-time need for nursing texts. Today Elsevier, thanks to its Mosby legacy, is the number-



*The Mosby imprint brought a whole new collection to the expanded company: texts for nurses and allied health practitioners. Today Elsevier, thanks to its Mosby legacy, is the number-one nursing publisher, producing both nursing texts and specialist works on subjects such as critical care, oncology,*

*emergency, mental health, pediatric and maternity nursing.*

one nursing publisher, producing both nursing texts and specialist works on subjects such as critical care, oncology, emergency, mental health, pediatric and maternity nursing.

Viewed as a whole, the work of the multiple enterprises that makes up the publishing company of Elsevier today is more than Jacobus Robbers could ever have imagined, and yet at its core the company has remained true to his founding mandate — simply to be a very good publishing company, worthy of the Elsevier name. The fact that Elsevier has published the work of every single 2004 Nobel Prize winner in Chemistry, Economic Sciences, Physiology or Medicine, and Physics — not to mention 86 out of 90 of the Chemistry laureates of the past 50 years — is a tribute to that tradition of excellence. However, Elsevier has not succeeded on excellence alone (just look at the fate of the much-esteemed House of Elsevir). Looking back on its history it seems doubtful that Elsevier could have been so successful had it not proven itself willing to take risks that were beyond the ken of Jacobus Robbers, both in terms of innovation and collaboration — be it by publishing the first international journal of biochemistry and biophysics in the 1940s, by helping to found the International Association of STM publishers in 1969 and CrossRef™ in 2000, or by launching revolutionary new services such as ScienceDirect.

Elsevier has always been willing to take risks and it continues to take risks, whether through financing a new journal in an emerging field, entering into new collaborative projects, or launching innovative products. Elsevier just recently launched Scopus, the world's largest abstract and indexing database, which covers more than 14,000 scientific, technical and medical titles. More than 300 researchers and librarians from over 20 institutions around the world were invited to participate in the development process, guiding Scopus's interface, features and functionality. The result is not only a solution built for scientists by scientists but a testament to Elsevier's commitment to serving and partnering with the scientific and health community.

Looking back at the past reminds us that the challenges and opportunities Elsevier now faces, as it moves into the future, are in some



*In summary, Elsevier's history resembles that of the researchers and practitioners that it serves: it is a story of innumerable contributions that collectively advance science and medicine.*

senses familiar ones. Just as in the late 1980s, Elsevier was obliged to revise its pricing system in response to the currency-exchange crisis, so today the company continues to adapt its pricing structures to the changing needs of its customers. Just as in the 1980s the company invested in experimentation to provide those customers with the most up-to-date electronic delivery formats, so today Elsevier continues to invest in the development of many and various new multimedia formats that will provide user communities with information in a number of ways, in a number of places, at any time they may need it. Just as in the 1970s the future of journals was challenged by contracting markets and the introduction of photocopying, today the company continues to address questions about open access to digital sources and issues of copyright in the electronic age. And just as in the 1990s, the company raced to innovate; today it continues to seek out breakthrough technology and products. Although electronic publishing like ScienceDirect,

Scopus and MD Consult are at the forefront of publishing innovation today, it remains clear to the company that the second Gutenberg Revolution has only just begun: with obsolescence only ever just one new innovation away, the company must continue to invest in experimentation even when, as has always been the case in science, experiments provide only promises, not guarantees.

The language of science is an ongoing issue for science publishers as well. Just as Latin lost ground to the vernacular in the age of Enlightenment, and German gave way to English after WWII, today the company needs to address the shifting locus of science toward Asia (in China advances in research are rivaling and even exceeding those of the U.S.). In 2004

Elsevier opened its first office in Beijing, and further expansion in Asia seems critical to future growth. This venture into uncharted territory is part of Elsevier's historical continuum, reaching out to find and disseminate new science and healthcare information beyond all geographic and political boundaries.

In summary, Elsevier's history resembles that of the researchers and practitioners that it serves: it is a story of innumerable contributions that collectively advance science and medicine. Many of those contributions go unnoticed, some are false starts, and the majority are incremental steps. Quantum leaps forward happen, but they are not the norm and even then, like the shift in the primary language of publishing or the migration to electronic formats, they often take years to happen. But as with researchers and practitioners, the constant in Elsevier's history — one that is reflected in its track record of risks taken, innovations led and mistakes made — is its goal to move forward, and to help its constituents do the same. As the company itself moves forward, this constant, distilled in its signature line — *Building Insights. Breaking Boundaries* — may ultimately prove the strongest factor in ensuring the longevity of that most resilient of publishing names: Elsevier.



## Sources

Interview - Karen Hunter, Senior Vice President, Strategy, Elsevier (December 24, 2004)

Interview - Michael Mabe, Director of Academic Relations, Elsevier (January 6, 2005)

William J. Broad, "Is U.S. Losing its Dominance in the Sciences," *New York Times* (May 3, 2004)

David W. Davies, *The World of the Elseviers* (Nijhoff, The Hague, 1954)

John L. Dusseau, *An Informal History of W.B. Saunders Company: On the Occasion of Its Hundredth Anniversary* (W.B. Saunders Company, Philadelphia, 1988)

Harcourt Brace and Company, *A History of Harcourt Brace and Company: 75 Years of Publishing Excellence* (Harcourt Brace and Company, Orlando, 1994)

S.L. Hartz, *The Elseviers and Their Contemporaries* (Elsevier, Amsterdam, 1955)

Einar H. Frederickson, "The Dutch Publishing Scene: Elsevier and North-Holland" in E.H. Fredericksson's (Ed.) *A Century of Science Publishing* (IOS Press, Amsterdam, 2001) pp. 61-76

Ekkehard Hundt, "German Post WWII Development and Changes in the Language of Science," in E. H. Fredericksson's (Ed.) *A Century of Science Publishing* (IOS Press, Amsterdam, 2001) pp. 97-106

J.K.W. Van Leeuwen, "The Decisive Years of International Science Publishing in the Netherlands after the Second World War," in A. J. Meadow's (Ed.) *Development of Science Publishing in Europe* (Elsevier, Amsterdam, 1980) pp.251-268

Pierre Vinken, "Foreword," A. J. Meadow's (Ed.) *Development of Science Publishing in Europe* (Elsevier, Amsterdam, 1980)

*ESWorld* (Elsevier's in-house magazine) 1986-1999

*Elsevier Today* (Elsevier's current in-house news brief)

Elsevier Timeline: 1880-2000 (written from the Dutch perspective):  
[www.let.leidenuniv.nl/history/res/bushis/timelinenieuw.html](http://www.let.leidenuniv.nl/history/res/bushis/timelinenieuw.html)

Elsevir History Website: [home.planet.nl/~taylorpj/elzevir.htm](http://home.planet.nl/~taylorpj/elzevir.htm)

Thanks also to Jackie Hatton for research, and to Elsevier employees John Schrefer, Peggy Bridges, Angelika Lex, Claudio Rothmuller, Celeste Giampetro, James Phimister, Wubbo Tempel and Ryoji Fukada for contributing personal stories and source materials.



ELSEVIER

Building Insights. Breaking Boundaries.™