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## BIMILLENNIAL HISTORICAL REVIEW

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### Part III. Progress in the 19th century

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“If I have seen further, it is because I have stood on the shoulders of giants”

SIR ISAAC NEWTON

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#### Introduction

The science and treatment of cancer is largely a 20th century phenomenon. The modern practice of surgical and medical oncology stems from the developments of the 19th century. This article considers the developments in science and medicine in Europe in that period. This was noteworthy for the acceleration of the Industrial Revolution, for the age of European Empires, and for profound social and political change in Europe and beyond. There was repeated conflict between the major powers, acting as a further stimulus to technological and social change. The acceleration from a rural, agrarian society to an urban, industrialized society unleashed great forces of political change. This took various forms in different states, from the French Revolution, through the Parliamentary reforms of Britain and the concept of electoral democracy, to Prussian autocracy and Russian monarchy. Over the horizon, independence for the USA and the US constitution had unleashed the immense creative and economic powers of the North Americans.

#### Communications, engineering and technology

The steam engine transformed travel in ships and on land. It allowed the great population migrations and the intermixing of cultures, and changed the expectations and opportunities of many Europeans. The telegraph and postal services improved communications. Photography allowed the accurate recording of images. The century ended with the arrival of the internal combustion engine, the motor car and the origins of powered flight. Technology and engineering also made huge contributions to public health. The distribution of clean drinking water and the removal of sewage were facilitated by great feats of engineering. The development of public sanitation and municipal discipline in public hygiene eliminated epidemics of disease and increased life expectancy.

#### Institutions

During the 19th century, scientific universities, academies and postgraduate institutions were established throughout Europe and the USA, and in most principal conurbations. They accelerated the growth and dissemination of knowledge and the growth of the professions.

The 19th century was also the era of the great civic, political and social reformers. It saw the growth of charities and of municipal philanthropy. Hospital building continued apace, such that well-designed, purpose-built institutions became a feature of every major town. Specialist cancer hospitals were built independently of general hospitals in Europe and the USA. In Britain, the Royal Marsden and the Christie hospitals, for example, date to this period. Critically, perception changed in certain institutions from fatalism and terminal care to the application of scientific and laboratory methodology in the treatment of malignant diseases. Florence Nightingale made her major contribution to the professionalization of nursing.

#### 19th century biology and medicine

There were dramatic developments in the life sciences. Our thinking about mankind and species was profoundly influenced by Charles Darwin's observations on evolution and the *Origin of Species*. Darwin provided an alternative and mechanistic explanation to challenge religious orthodoxy for the existence of man.

#### Microbiology

Many of the major discoveries were linked to infectious diseases, such as Jenner's smallpox inoculations of 1798. The classification of disease was a particular feature of this period and the importance of microbes in the transmission



Fig. 1. Daguerreotype of the second operation performed under ether general anaesthesia, Boston, October 1846 (Reproduced with kind permission of the Boston Medical Library, USA).

of disease was recognized. We note the work of Louis Pasteur (1822–1898); of Joseph Lister (1827–1912), who introduced antiseptics, carbolic acid and sterile sutures; and of Robert Koch (1843–1910), who discovered anthrax, tuberculosis and thermal killing of bacteria.

Lister's life also provides a graphic illustration of the value to surgery of a broad technical and multidisciplinary education. As one of the few surgeons trained in microscopy, he was better placed than most at the time to recognize the relevance of Pasteur's work to his own surgical practice, a lesson which remains as important today as it was then.

### Cellular pathology

The science of cell biology was not fully established until the 19th century. For example, Robert Brown (1773–1858) discovered the cell nucleus. Theodor Schwann postulated that the nucleus was the reproductive organ of the cell, and linked embryonal development to tissue form. Johannes Muller (1801–1858) linked the cell concept to the spontaneous development of cancers. Jacob Henle (1809–1895) argued that metastases were due to migrating cells displaced from primary tumours. Virchow (1821–1902) believed that tumours arose from embryonal cells in connective tissue, while Waldeyer (1837–1921) recognized the epithelial origin of epithelial cancers. Everard Home

(1756–1832) published the first recorded illustrations of malignant tissue as late as 1830.

Clinical cellular pathology was further advanced with the publication of the great works of men such as Hodgkin, Baillie, Addison, Rokitansky, Horner and Gross. James Paget (1814–1899) described his eponymous malignancy of the breast in 1874. John Bennett (1812–1875) and Virchow described leukaemia in 1845. The importance of environmental carcinogenesis in the industrializing world was also recognized, following Pott's earlier work. Occupational lung cancer was reported in Black Forest miners in 1879. Bladder tumours were noted in aniline dye workers in 1895. Conversely, tobacco-associated lung cancer barely featured in the 19th century records.

### The emergence of cancer as a clinical problem

Cancer is in general a disease of societal advancement and the price that we pay for longer lives. It generally arises in the later years of individual lives. Against a background of short life expectancy and the dominance of infective disease in earlier times, cancer does not seem to have figured as a significant challenge to medical practice. Its emergence to significance is thus inextricably linked with all the factors which have improved our lives, including sanitation, hygiene, housing, economics, technology and trade.

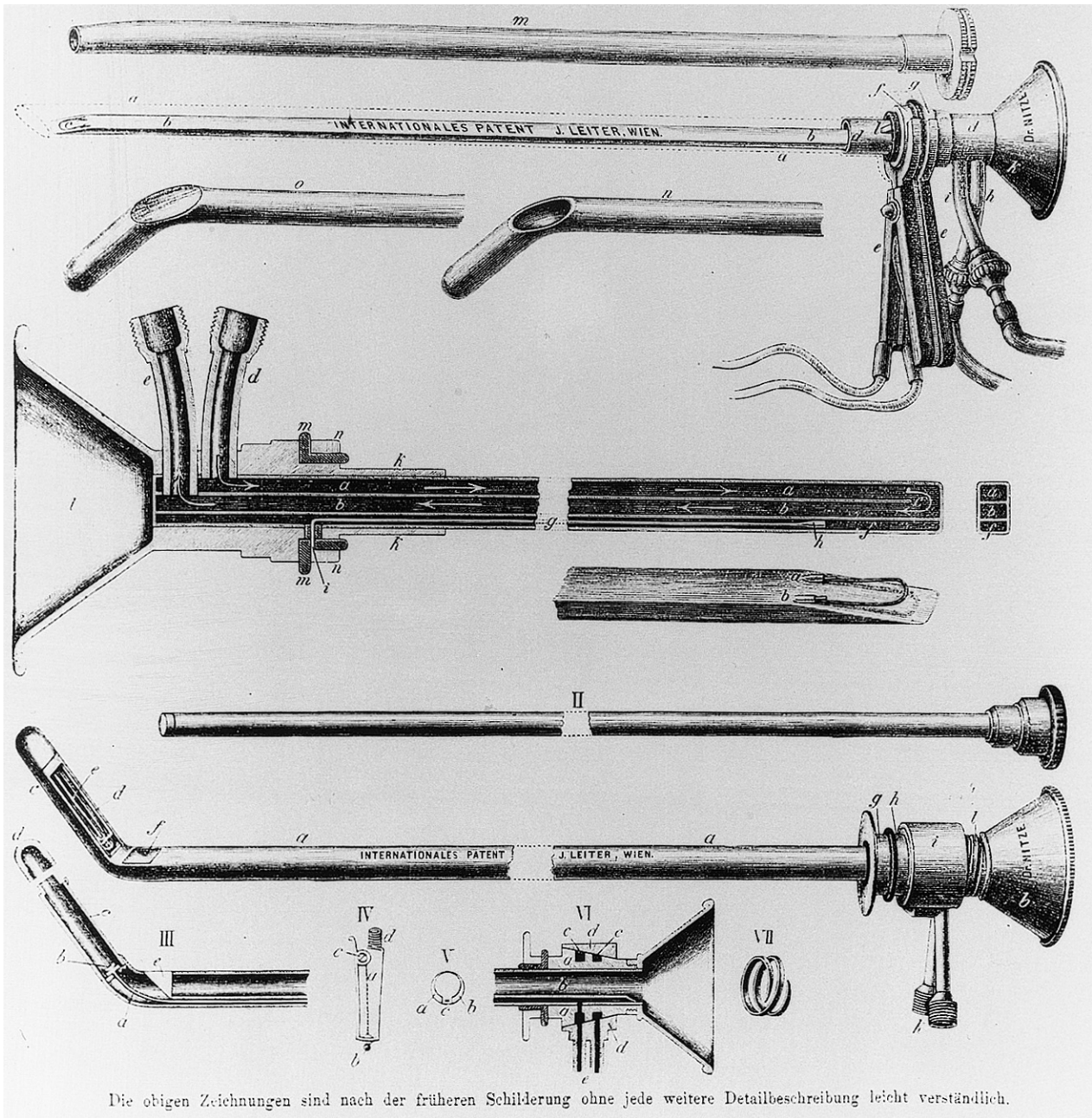


Fig. 2. Drawings of the first electric cystoscope, produced by M. Nitze in 1877. This illustrates the technical and engineering advances in instrumentation during the 19th century. (Reproduced with kind permission of the National Library of Medicine, MD, USA).

Industrialization, trade and technology also promoted environmental carcinogenesis, in the spread of tobacco derivatives, for example. The emergence of cancer thus paralleled economic and industrial developments.

By the end of the 19th century, neoplasms were recognized as discrete entities from inflammation, their cellular origins and embryology were established and classified, and their biological behaviour (invasion and metastasis) was described. However, pathology and surgery remained well separated, with a limited influence of pathology upon clinical practice and patient management. Radiation and its medical applications arrived in the 1890s. Roentgen (1845–1923) discovered X-rays (1895), which were rapidly adopted,

although their dangers were not initially appreciated. Marie Curie discovered radium in 1898.

#### 19th century surgical practice

This period saw the emergence of the surgical craft as a respected specialization within medicine, but the range of practice remained little changed from earlier generations until the mid-19th century. Abdominal surgery, for example, remained largely out of bounds, because of the associated mortality and the difficulties for patient and surgeon without anaesthesia. The use of anaesthesia, antisepsis, the rise of



Fig. 3. Theodor Billroth operating in the Allgemeine Krankenhaus, Vienna, 1889, painted by Anton Seligmann. (Original in the Osterreichische Galerie, Vienna).

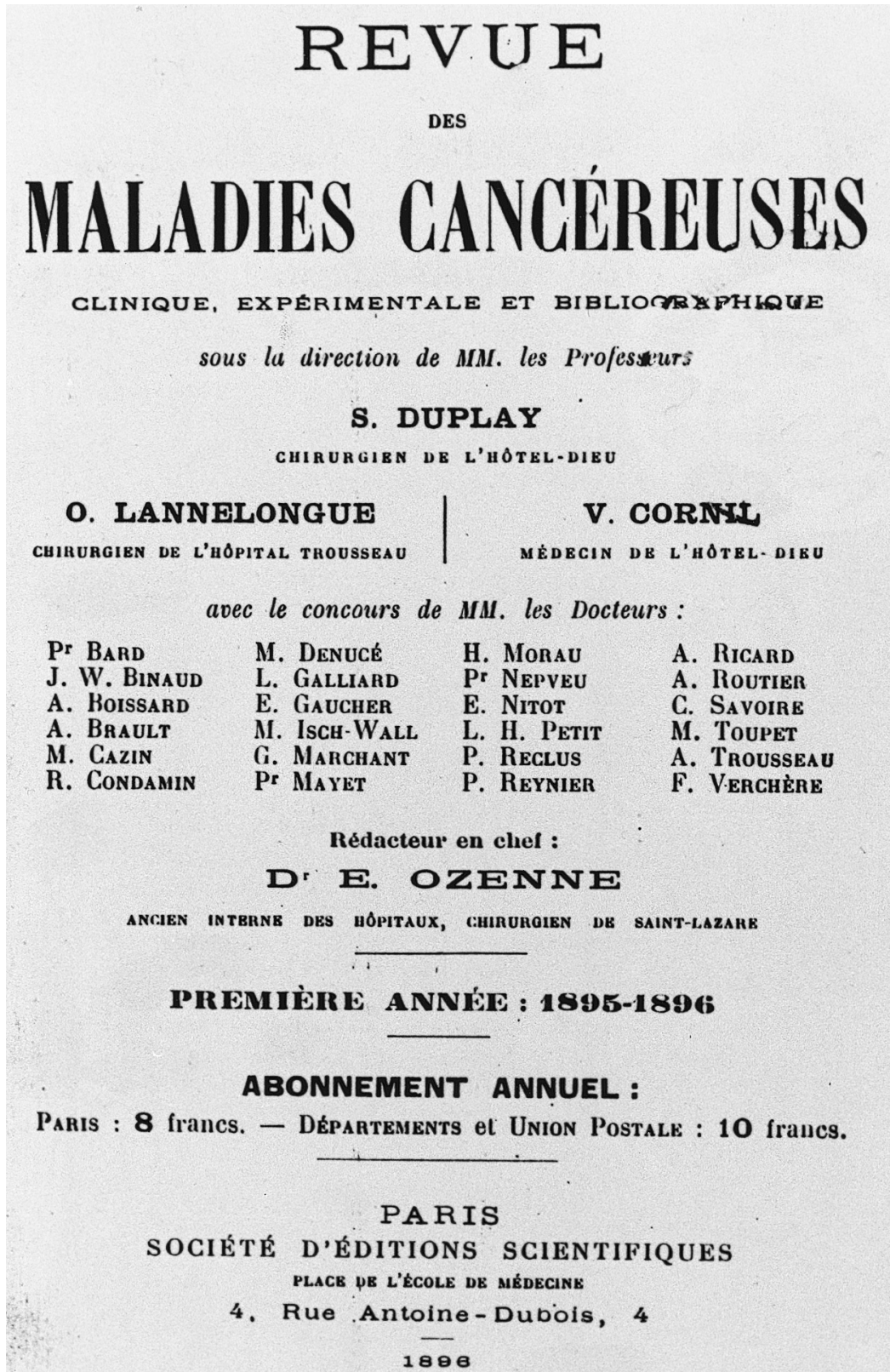


Fig. 4. Frontispiece of the first issue of the Revue des Maladies Cancereuses, 1896 (see text). (Courtesy of the librarian, the Royal College of Surgeons of England).

the nursing profession and many other factors contributed to a dramatic take-off for innovative surgery in the mid-19th century. Surprisingly, acute appendicitis was first diagnosed and excised in the UK as late as 1880 by Lawson Tait.

It was not until late in the 19th century that many of the major cancer operations which we now practice were adequately described. For example, Billroth in Vienna first performed a laryngectomy for cancer in 1873. Halsted described radical mastectomy in 1892. Wilms first excised his eponymous tumour in 1899, while Wertheim first performed a radical hysterectomy for cancer in 1898. The early statistics for cancer surgery were not encouraging. Billroth reported a 3-year survival of under 5% in 170 breast cancer cases operated upon between 1867 and 1876.

Advances in surgery were predicated upon many scientific and technical developments. The rise of experimental physiology in the 19th century paralleled that of pathology, with the work of men such as von Helmholtz, Bernard, Beaumont and Pavlov. The key developments of the mid-19th century were in anaesthesia. Ether, nitrous oxide and chloroform were discovered in the 1830s. The introduction of ether anaesthesia at Massachusetts General Hospital in 1846 revolutionized surgery. Developments in instrumentation and technology were also important. The practical rubber glove was patented in 1878 in England. Halsted popularized its use around 1890. Technology in steel, rubber, sutures and other materials, in the provision of clean water and electricity, were all to affect the working environment of surgeons.

#### Societies and journals

A more open approach to the dissemination of knowledge through meetings and journal publications in the 19th century overturned the earlier habits of trade secrecy. Of particular note was that the internationalization of medical

exchange through major congresses took place throughout Europe and the USA from 1869 onwards. This habit was facilitated by mass transportation, and expanded until the onset of World War I. The first specialist cancer journal, the short-lived *Revue des Maladies Cancereuses*, was published in France in 1896.

#### Conclusions

By 1900, the foundations of modern medical practice and the social, cultural and economic framework of the modern industrial world were well in place. The status and professionalism of the surgeon was established and the structure of modern institutional practice was discernible. Cancer was emerging as a major cause of morbidity and mortality in a healthier population with greater longevity and expectations. In the fourth article of this series, we will consider some of the influences and developments of the 20th century. This has been perhaps the most remarkable century of all for its rate of change, its technical innovation and achievement, if not, as yet, its conquest of cancer.

#### Further reading

1. Goodman D, Russell CA. *The Rise of Scientific Europe 1500–1800*. London: Hodder and Stoughton/The Open University, 1991.
2. Rutkow IM. *Surgery: An Illustrated History*. St Louis, MO: Mosby, 1993.
3. Cantor D. Cancer. In: Bynum WF, Porter R (eds). *Companion Encyclopaedia of the History of Medicine, Vol. 1*. Oxford: Oxford University Press, 1993: 537–61.

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 W2. [www.mic.ki.se/history.htm](http://www.mic.ki.se/history.htm)