VISUAL PROSTHESIS AND OPHTHALMIC DEVICES
Retinal Degenerations: Biology, Diagnostics, and Therapeutics, edited by Joyce Tombran-Tink, PhD, and Colin J. Barnstable, DPhil, 2007
Ocular Angiogenesis: Diseases, Mechanisms, and Therapeutics, edited by Joyce Tombran-Tink, PhD, and Colin J. Barnstable, DPhil, 2006
The history of medicine has been substantially defined by a small number of monumental discoveries. Most of these breakthroughs have emerged from the biological sciences. One of the first great breakthroughs was the recognition by Koch in 1884 that pathogens could be transmitted from one living organism to another to cause disease. This profound concept led to a revolution in the approach to patient care that ultimately led to introduction of “sterile” techniques that greatly improved survivals of patients. This knowledge promoted the discovery of antibiotics 40 years later, which dramatically increased life expectancy throughout the more developed parts of the world.

Another great milestone that has influenced medical care was the use of anesthesia for surgery, which was first introduced in 1846. Collectively, these three discoveries armed physicians with the knowledge and means to substantially reduce the prevalence of infectious disease, which was and still remains the leading cause of death throughout the world, and to perform a much wider range of surgeries with greatly improved survivals. The improved life-expectancies enabled the medical community to focus on a wider range of medical problems and solutions to disease.

Today’s modern age of medicine is being defined mostly by the benefits of the discovery of the structure of DNA by Watson and Crick in 1953. This landmark discovery enabled the revolution in the diagnosis and treatment of heritable diseases through the use of molecular genetic techniques, including the development of the polymerase chain reaction, which, like the work on DNA itself, was ultimately honored by a Nobel prize. This knowledge spawned the field of proteomics research that is now providing insights into disease mechanisms and new biological therapies.

The physical sciences have also played important roles in the development of the field of Medicine. The most significant contributions have perhaps come from the field of Physics, which provided basic X-ray technology, and roughly 80 years later the giant leap forward with the introduction of computer-assisted imaging in 1972. Since that time, there has been a natural evolution toward more detailed and elaborate imaging methods, especially magnetic resonance imaging, functional magnetic resonance imaging, and positron emission tomography. Not surprisingly, that seminal discovery of computed tomography was also awarded a Nobel prize.

In the last decade, we have seen a fusion of the biological and physical sciences in the development of the field of Ophthalmology. Translational research in these fields has resulted in the design of inorganic materials that can aid, improve, or replace biological functions of the eye. High-quality stereoscopic microscopes enabled the modern age of ophthalmic surgery, which has been defined mostly by the introduction of artificial intraocular lenses. Since Sir Harold Ridley implanted the first artificial lens in 1949, vast improvements in materials and designs over the ensuing two decades have enabled Ophthalmologists to dramatically improve the quality of life for their patients by inserting flexible artificial lenses with minimally-invasive surgical methods. Patients no longer have to endure prolonged “recovery” times, and the visual outcomes are routinely very good. These and other advances, including the very early use of LASER technology, have led to an era of exploding technological ingenuity and
have earned the field of Ophthalmology the reputation of being one of the most *avant-garde* fields of medicine.

This textbook, entitled *Visual Prosthesis and Ophthalmic Devices: New Hope in Sight*, provides the most comprehensive overview of the new technologies that are defining the modern age of Ophthalmology. Two themes are presented in this volume. In the first, we explore the interface between the eye and inorganic materials that are being used either to improve the drainage of aqueous fluid in the treatment of glaucoma or to improve the quality of vision by enhancing the ability of the eye to focus images. In the second, we explore the interface between electronics and the nervous system, in which dramatic progress has been made in improving vision with microelectronic devices that bypass irreparable ocular tissue malfunction. The technologies presented in this textbook have been developed through collaborations with many types of scientists, most notably optical engineers, materials scientists, electrical engineers, microfabrication specialists and circuit designers. This collective body of work provides a perspective on a stunning array of new technologies that redefine the limits of medical mechanics and that will influence the delivery of care to patients with many types of ophthalmic problems. Some of these innovations are “platform technologies” that with some modification could likely be used to treat other types of medical problems.

Most of the technologies discussed in this book have been developed only within a couple of decades. This pace of development and implementation is a very impressive accomplishment, given the extremely challenging obstacles that are always in the path of innovative technologies that are intended for implantation into humans.

The field of Ophthalmology is immersed in a new, exciting, and seemingly endless age that holds the promise for new diagnostic and therapeutic options to treat visual disorders. The multidisciplinary scientific approach that was required to develop the devices described in this book will likely inspire others to challenge current boundaries that limit integration of microelectronics and medicine. The authors of this textbook serve as role models for a new generation of students who have become energized by this type of applied biomedical research. Today’s students will be the torchbearers in the future for biomedical innovations that restore vision to the visually-impaired and that protect vision for those patients who are under the threat of blindness.

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