tories across India. In the first chapter, the author attempts to put in perspective the nanoscale and also to convey the significance of nanostructured materials. It is a pity that a considerable proportion of the statements is unfounded and that quite a few are disconnected. This demands greater perserverance on the part of the reader to continue. Of much greater concern is the frequent occurrence of factual errors (e.g. 'one thousand bacteria could be placed in 1 nm') that can confound the uninitiated. The second chapter highlights the importance of characterization tools in providing insight into nanoscale properties. Here, apart from the factual errors (e.g. 'nanometer-size gold crystals are attached to the tip of a scanning probe in a technique called surface-enhanced Raman spectroscopy'), the various attempts to explain the different principles and mechanisms involved in electron and scanning probe microscopy are quite obtuse (e.g. 'externally visible ultra sharp tip [with a radius of 20 nm]') and would tax an expert scientist's wit to divine the author's intent; the uninitiated layman stands little chance. The next six chapters talk about nanomaterials, nanoelectronics, biomedical technology, genetics and the potential windfalls of nanotechnology. Factual and grammatical errors abound in these chapters too, and the author really lets down his readers with statements such as: '... the capacity to detect extremely small motion of matter [millionths of a nanogram] called the quantum limit'; 'Biosensors to measure blood glucose are under development. A single nanotube can detect glucose. The sensors use gold nanoparticles'. These chapters represent a sort of challenge to people so inclined; however, the average reader would have appreciated a little more substance and coherence. The last two chapters are sensationalized accounts of the enhanced risks attributable to nanotechnology with a caveat that humans will eventually adapt to these risks.

Although efforts to write books explaining nanoscience and technology to the layman are in general commendable, this book leaves a lot to be desired.

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Biomedical engineering is an exciting area of research, a forerunner to today's 'mantra' of interdisciplinary research and the trend of prefixing 'bio' to emerging areas. It involves the application of engineering principles to problems in biology and medicine. While its origins can be traced back to Wilhelm Roentgen and his X-ray imaging set-up of the early 1900s, it started to blossom in the post World War II era and came to the fore in the late 1950s. It spans a wide spectrum covering bioimaging, biomechanics, medical electronics, prosthetics, cellular and molecular bioengineering, computational modelling, biomaterials and biosensors. It is a formidable effort to do full justice to the task of spanning the field of biomedical engineering using 19 articles. The *2006 Annual Review of Biomedical Engineering* attempts precisely this and succeeds admirably in painting a bird's-eye view of the field and its vast scope.

Bioimaging uses electromagnetic radiation to non-invasively interrogate cells, tissue, organs and organisms, creating spatial intensity maps of physically relevant parameters. Imaging of cellular and sub-cellular processes has greatly benefited from advances in fluorescence microscopy and the development of novel reporter molecules, notably Green Fluorescent Protein (GFP) and its variants. Gene expression and regulation and its spatial distribution can now be visualized by making the transgene encode the GFP and subsequently imaging the fluorescence generated. Various technologies and reconstruction techniques have been developed for *in vivo* fluorescence imaging from the cellular to the organismal level (macroscopy). At the other end of the spectrum, methods like whole-body computerized tomography (CT) and magnetic resonance imaging (MRI) scans provide a physician powerful diagnostic tools for the detection and characterization of tumours, infection and disease states. Of late, multi-modality imaging has become an attractive strategy for combining complementary information generated by disparate modalities. Typically, structural and functional information for instance, from CT and nuclear or fluorescence imaging, is superimposed to yield composite images which are diagnostically more informative. Emerging modalities include imaging conductance variations in biological tissue using a method called electrical impedance tomography (EIT). Reconstruction algorithms in EIT adapt or modify methods that have been developed earlier for electron microscopy, nuclear imaging and X-ray CT. The basic principles of these novel imaging methodologies are covered in three papers and illustrated with exemplary images taken from animal and human subjects.

Phenomenal advances in molecular and cell biology are being used by molecular bioengineering to enhance our understanding of cellular-level signalling and transduction, cellular and molecular responses to inflammation, infection and cancer, and are opening new avenues. The cascade of microvascular and molecular processes that constitute inflammation along with a new hypothesis for generation of inflammatory mediators is analysed. With the explosion in drug discovery, the problem often faced is targetting these drugs both spatially and temporally. These are challenging problems that bring together chemical engineers, chemists and biologists to create new classes of smart drugs and drug-delivery vehicles. New classes of molecules – polymersomes, which are self-assembled amphiphilic polymer shells, small double-stranded RNAs called small interfering RNAs (siRNA), pH-sensitive and immuno-liposomes are discussed in three papers along with their action mechanisms and challenges in intracellular targetted drug delivery. The more recent fields of genomics and proteomics are represented by papers that discuss, using an integrated systems approach, the structure–functional relationships of a class of polysaccharides called glycosaminoglycans, that play an active role in cell surface-level interactions and influence cell growth and development.

Physiological modelling is critical in enhancing our understanding of biochemical and biophysical processes. An interesting paper from a mathematics group presents a computational model of angiogenesis (new blood vessel formation) using differential equations and fluid mechanics to model the effects of blood flow on vessel growth and proliferation. This has important implications in the

chemotherapy of solid tumours, which pose problems in drug delivery, and in the design of anti-angiogenic drugs. Another paper reviews the large body of literature devoted to heat shock proteins (HSP) and models their expression using numerical methods. Understanding HSPs is useful in providing protection to cells from stress using prior exposure to mild stress.

The development of new biomaterials is critical to implantable devices and organ transplants due to their ability to minimize adverse reactions of the body to these foreign objects or tissues. They are also useful as drug-delivery agents in gene therapy and targetted anti-mitotic drugs. Biodegradable materials like sutures are also being increasingly used. Bioresorbable drug-eluting stents are an appealing alternative to metallic stents, that suffer from restenosis due to neo-intimal hyperplasia. Stents are used not only in cardiovascular applications but also in urological, bronchial and gastrointestinal systems to main structural integrity of the lumen of conduits.

Biomechanics deals with the study of circulation, mechanical properties of tissue and bones, and locomotion. A paper outlining the mechanical and molecular regulation of bone remodelling is presented by a diverse group with members from anatomy, biomedical engineering and orthopaedic surgery! Biomechanical redesign of coronary artery bypass graft (CABG) for better outcome and patency is proposed, using mechanical homeostasis of the blood vessel as a determinant of its growth and remodelling. The principles of engineering design and fluid mechanics are used to study homeostasis and outcomes of CABG.

Computer-aided diagnosis of disease is still in its infancy due to the complex, multi-dimensional and multimodal nature of clinical data. Machine-learning uses supervized and unsupervized algorithms that adapt their parameters based on the data. Bayesian inference and other learning methods are reviewed in the context of disease detection and classification in one paper. Disease prognosis and predictive modelling have been studied since the 1980s, especially in critical care. Some of the major mortality-prediction models are reviewed along with their statistical methodology in another paper.

The compendium concludes with a fascinating article entitled 'Lab on a CD', describing a novel CD-based platform for medical diagnostics and high throughput drug screening using centrifugal force-based biofluidics. It also describes an ingenious adaptation of a commercial CD drive for high-resolution optical imaging. Another paper from an electrical engineer discusses the use of electrical forces to manipulate cells at a microscale using dielectrophoresis to design systems for separating or moving cell mixtures. The ideas in these two papers are forerunners for a futuristic lab-on-a-chip that has the potential to reduce the cost of disease diagnosis. They also foreshadow the role of nanoengineering and nanoscience in the near future.

In summary, the *2006 Annual Review of Biomedical Engineering* takes the reader, presumably an engineer, applied scientist or a basic scientist interested in clinical applications, on a whistle-stop tour of the vast expanse of biomedical engineering. The volume should also be of interest to students who wish to specialize in biomedical engineering, but are overwhelmed by its sheer range. The vision of the book, while broad in its sweep, does have a few blind spots. Notable omissions include advances in prosthetic devices like the bionic arm and implants, developments in brain–computer interfaces, as well as breakthroughs in modelling such as metabolic control analysis.

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