Chapter 9
Genomic Technologies and the Emergence of BRICS (Brazil, Russia, India, China, and South Africa)

ABSTRACT

In this chapter, we will discuss China being on record as one of the most progressive member of BRICS (Brazil, Russia, India, China, and South Africa). The huge population census, the high literacy rate, coupled with the training and graduation of over 300,000 technical experts annually are abundant evidence for China to become a leader in genomic science among the BRICS. The state-of-the-art technological resources for sequencing, which were recently acquired in China, has facilitated the accomplishment of innovative sequencing of animals, plants, and insects, which are components of the ecological fauna and flora of Asia. The Beijing Genomic Institute is the largest genome-based research organization in the world. Other progressing developing nations such as Brazil, Russia, India, and South Africa are making steady progress in genomic science.

CHINA'S PREEMINENCE

We must reiterate that the completion of the Human Genome Sequencing (HGS) sponsored by the United States Department of Energy and the National Institutes of Health (NIH) is comparable to the feat associated with theory of relativity propounded by Albert Einstein in the 20th century. In 1915, Einstein completed his general theory of relativity, a theory of gravity which demonstrates more precision than that of Sir Isaac Newton. Besides, Einstein also illustrated that photoelectric effects involving ejection of electrons from metal by action of light can be explained, if light has particle nature as well as wave characteristics. These discoveries have many and varied implications in engineering, physics, electronics and our understanding of the global planetary systems (Einstein, 2000). However, the contrast with the human genomic sequencing involved the individual feat of Einstein whereas in genomics, the

DOI: 10.4018/978-1-4666-8559-8.ch009

main collaborative group includes scientists at the NIH the United States Department of Energy and numerous scientists from European Union, Japan, and China. This scientific team is now described as the International Human Genome Sequencing Consortium (IHGSC).

China, with a population of 1,349,586,838, has become not only the most progressive nations economically among the BRICS (Brazil, Russia, India, China, and South Africa), but also the most populous nation in the world. Besides being a multi-ethnic society, China produces over 300,000 qualified engineers annually. The life expectancy is currently 73.0 years for males and 77.3 years for females, with an infant mortality rate of 15.2/1000. The per capita gross domestic product (GDP) of 12.8 trillion dollars by far exceeds those of France (2.3 trillion dollars) and Canada (1.5 trillion dollars).

Among the BRICS, China was the only developing nation that contributed toward the accomplishment of the HGS project. At the outset, scientists at the Beijing Genomics Institute (BGI) contributed 1% to the Human Genome Project's (HGP's) reference genome, and 10% to the Human HapMap project to achieve the scientific landmark.

With the initiative of March 25, 2003, China had a characteristic geographic advantage and the scientifically literate workforce with one of the highest GDPs in the world. China is on the path to massive economic prosperity derived from genomic science.

In a thirteen-year span, post completion of the HGP, biology not only assumed the status of a preeminent science, but in the industrialized nations, genomic technology centers emerged, the commercialization of genomic-oriented medical establishments was developed, and biotechnological enterprises flourished. They were developed to focus on the domestic health needs and environmental challenges of these nations. Inadvertently, less emphasis was placed on endemic diseases and teething economic problems of the developing nations.

GENOMIC TECHNOLOGIES AND RESOURCES

Once the HGS was accomplished by April 2003, new genomic technologies and startup companies were established. These innovative companies include the 454 life sequencers manufactured by Roche Diagnostics (Brandford, CT) chromatography and electrophoresis, gene amplification, capillary analysis, polymerase chain reaction tests, microarray sequencing and iso-electric focusing, high-performance computing equipment, broadband infrastructure, data visualization equipment, bio-photonics, robotic equipment, vision science equipment, climate research atmospheric science equipment, and bioprocessing engineering equipment, among others. A comprehensive list of these state-of-the-art science technologies was reported by Ebomoyi and Srinivasan (2008).

The United States Department of Energy (2008) emphasized the applications of genomic technologies in molecular medicine, microbial science, risk assessment activities, bio-archaeology anthropology, evolution, and human migration patterns. Additional applications of genomic resources consist of forensic science, agricultural development (especially livestock breeding), and bioprocessing.

In order to facilitate the process of data storage, data mining, and processing, the United States Department of Energy at its Oak Ridge National Laboratory recently upgraded a Cray XT5 high-performance computing system by transforming it to the "Jaguar" super computer as the world's fastest. This computer is the most powerful computational machine for finding solutions to some of today's intricate and tantalizing problems. This upgrade consumed 19.9 million dollars under the U.S. Recovery Act (U.S. Department of Energy, 2010).