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The next generation of scientists: A bright future or a black hole

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ABSTRACT

Over centuries science has been a growing panacea for life. The success of science has proven human intelligence beyond imagination. Babies conceived in test tubes to creating clones are just to name a few. Often our mind boggles to think beyond this unstoppable progress, whether this unbridled success is aimed for eternity until human existence or will it ever see a decline? In the current euphoria we tend to neglect the existing flaws that the system holds and overlook its vulnerabilities. The false assumption of the never-ending growth of biomedical sciences has created a highly competitive system that is disrupting the supply and demand ratio and discouraging fresh talent to enter our profession. The supply of biomedical scientists has increased dramatically despite considerable evidence for the scarcity of permanent positions in the academia. The backbone of the biomedical system that bears all the brunt is the academia that carries out the majority of basic research, despite their shrinking share of grants and incentives. The current system is in state of disequilibrium, generating an ever-rising supply of scientists competing for limited research resources and employment opportunities. The resulting strains have reduced the entry of newcomers in our profession. In context of such perils there is increasing amount of uncertainty about the future of this field. The time has come to think of a possible remedy to ensure that this system remains sustainable and continue to have more people continue to choose science as their career.

KEY WORDS: POST DOCTORAL FELLOWS, BIOMEDICAL ENTERPRISE, SCIENCE, RESEARCH.

INTRODUCTION

Scientific advancements today have reached its pinnacle. During the past few decades scientists have come up with the most astonishing discoveries regarding the very fundamental to the most advanced scientific arenas. With the discovery of the central dogma of genetics to the intriguing language of our DNA; from the basis of cell cycle to demystifying the cross talks between the cells; scientists have been able to answer many of the baffling questions about life and diseases. Many life threatening diseases are now diagnosed and often

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prevented, controlled, or cured with measures based on these discoveries. However with this spree of success we have failed to acknowledge that the present scenario holds basic defects which will result in a possible decline in the near future. One of the pivotal reasons of this possible decline is the imbalance between the available funds and the growing number of scientific community. This disproportion has created a highly competitive environment that hampers scientific productivity and quality, (Wente, 2015)

Post World War II there emerged an increasing need for science and research on a global basis. The number of Universities grew to meet the economy's need for more graduates and more budgets were reserved throughout nations to build better scientific infrastructure. This framework broadened with the span of baby boom and the increasing population rate throughout the world. For decades researchers simply had to focus on producing great science. They had no trouble winning government grants to conduct their work. However the influx of high funds somewhat ceased in the mid 2000 with the global recession and the increasing costs of research.

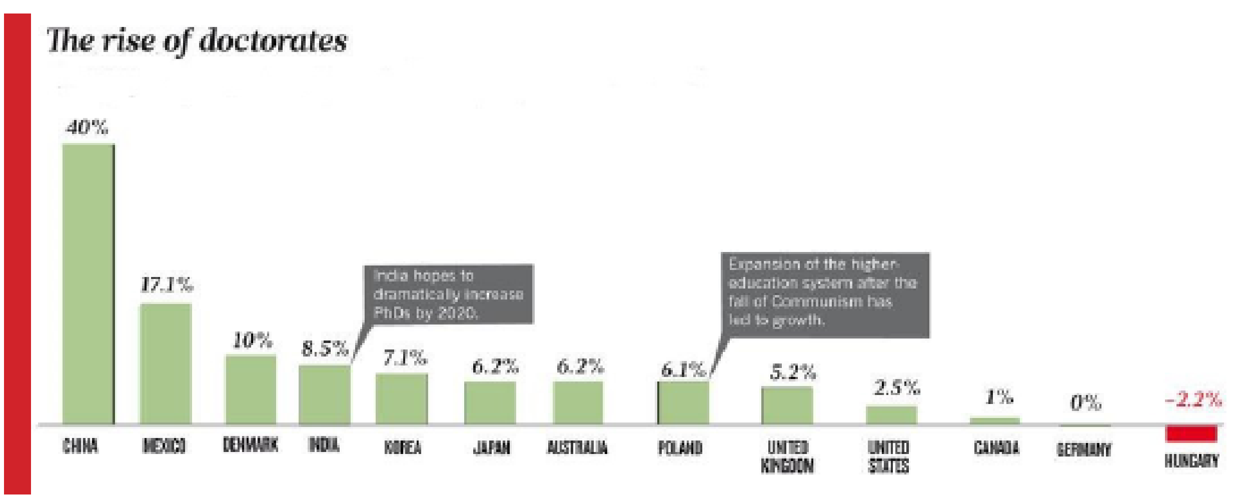
The growing technology came with high price tags which lopsided the supply and demand ratio. The demand for research and the growing number of incumbents in the field of science surpassed the successful grant sanctions, which resulted into high competition and low productivity. The majority of biomedical research is conducted by graduate and postdoctoral trainees. However, the training pipeline produces more scientists than available employment opportunities in government, academic and private sector which results in disrupting the equilibrium. Consequently, the prospects of a rewarding biomedical career would diminish with passing time and would further cause a decline in the number of people opting for scientific careers as malpractices corruption and academic parasitism is on the rise, (Ali, 2014, 2014a and AAAS, 2015).

ROLE OF HIGHER EDUCATION AND RESEARCH

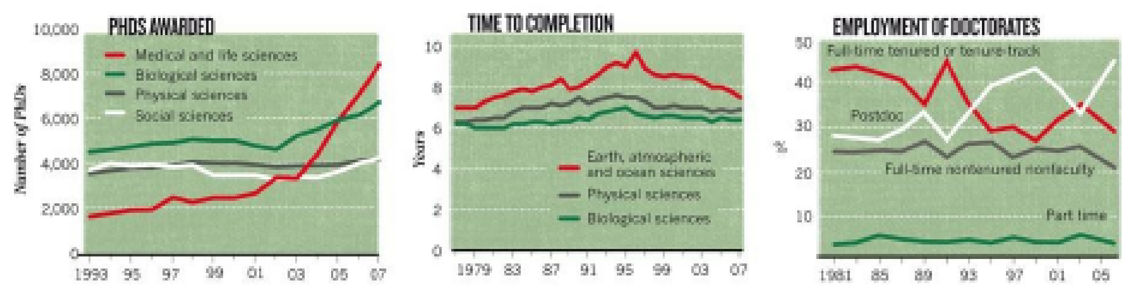
The improvement in health care relies on the discovery of new medicines therefore a strong financial support for research to generate new medicines is important. The journey of a drug from its discovery to approval takes 30-40 years approximately. The major fraction of time from the recognition of the novel target and its potential link to the medicine; preclinical studies- is carried out in the Universities by graduate and post doctoral trainees. Therefore it not just requires a greater emphasis on academic based research but a strong financial backing to facilitate basic discovery.

In developing nations like India the explosive growth of economy and population the government is making major investments in higher education and research — including a one-third increase in the higher-education budget in 2011–12 — and is trying to attract investment from foreign universities. The hope is that up to 20,000 PhDs will graduate each year by 2020, says Thirumalachari Ramasami, the Indian government's head of science and technology. Those targets ought to be easy to reach: India's population is young, and undergraduate education is booming (Cyranoski *et al;* 2011).

But there is little incentive to continue into a lengthy PhD programme, and only around 1% of undergraduates currently do so. Most aim on securing jobs in industry which require only an undergraduate degree and are much more lucrative than the public-sector academic and research jobs that need postgraduate/postdoctoral education. Students "don't think of PhDs now, not even master's — a bachelor's is good enough to get a job", says Amit Patra, an engineer at the Indian Institute of Technology in Kharagpur. Even after a PhD, there are few academic opportunities in India, and better-paid industry jobs are the major draw. "There is a shortage of PhDs and we have to compete with industry for that resource — the universities have very little chance of



United States: What shall we do about all the PhDs?



(Source: Cyranoski *et al;* 2011)

winning that game," says Patra. For many young people intent on postgraduate education, the goal is frequently to go to the United States or Europe (Cyranoski *et al*; 2011)

Major expansion of higher education has boosted Ph. D graduates across nations, shown here average annual growth, (Source: Cyranoski *et al;* 2011)

In the United States the annual number of science and engineering doctorates graduating from the universities rose to almost 41,000 in 2007, with the biggest growth in medical and life sciences. It took a median of 7.2 years to complete a science or engineering PhD – yet the proportion that landed into full time academic jobs within 1–3 years of graduating is dwindling.

SOME SOLUTIONS TO THE PROBLEMS

Typically researchers spend 5-6 years in graduate school and then move towards pursuing their scientific quest for post doctoral positions. Almost 90 percent of PhD graduates from the universities go for postdoctoral fellowship; it almost seems to be the obvious next career step. These highly skilled scientists are the backbone of scientific research, yet they are often poorly rewarded and have no way to progress in academia. But after several years of doing research, do grad students really need to toil away as a postdoc? Although there are exceptions, the prevailing opinion is that doing a postdoc is a requirement for anyone who wants to be a professor running his or her own research group. Statistics reveal that the number of postdoctoral fellows in science has ballooned: in the United States, it jumped by 150% between 2000 and 2012. Surprisingly, the number of tenured and other full-time faculty positions, has remained constant, and in some places it is even shrinking (Cyranoski *et al;* 2011). In the United States alone there are approximately 63,000 affiliated post docs devoting their life to science. "Also there is a huge discrepancy between the aspirations of most researchers and the realities of the academic world," says Paul Wicks, a post doc in the Institute of Psychiatry at King's College London. "Post docs need help to prepare effectively for future careers, but it is unclear who should be taking responsibility."

It is surprising that these fellows are earning income that barely allows them to afford child care and other real estate opportunities. Clearly they are not aiming to earn money. Also unfortunately, the postdoctoral duration sometimes stretches beyond a reasonable time frame. The problem of extended postdocs has been around for a while in the biomedical sciences, says Stacy L. Gelhaus, a research assistant professor at the University of Pittsburgh. "A lot of places have a five-year time limit on postdocs," Gelhaus says, "but not a cumulative time limit." And that leads to another troublesome trend. "Particularly in more biological areas, many current postdocs have previously been postdocs for one or even two appointments. "For these individuals, the second, or later, postdoctoral appointment serves largely as a buffer zone in the rise and fall of the job market. Furthermore, there is the worry of getting a permanent job at the end and, related to that, the slow pressure to succeed academically and produce outstanding research," explains Steven Gratton, a postdoc astronomer at the University of Cambridge. "The postdoc system runs a risk for academia, as some of the best people may think it's not worth the hassle. So academia, particularly away from the very top institutions, might get the persistent but not always the excellent people."

"We've always been at risk of producing more scientists than we have places for, but the stresses and strains were not harmful in the way they are now," says Shirley

Tilghman, president emerita of Princeton University in New Jersey. "Some changes will have to happen". But what options do we have? Or are there any corrective measures which could improve this situation? How can we continue to attract young people into science and how can we tailor their training requirement. Is the current length of the training period right? Are there enough alternative career options available? Are we mentoring them in the right way? Are our labs structured correctly, with the right distribution of various kinds of trainees and staff scientists?

Postdocs have options other than the university professorships, many of which require some postdoctoral training. For example, journal editorships, many positions in pharmaceutical companies and biotech companies, and other jobs at teaching institutions all often require at least a short postdoctoral training. So it is necessary to plan the postdoctoral training period according to an individual's particular career goals. More emphasis should be given to the training, development, and experience of graduate students and postdoctoral fellows. Not just to make discoveries, but to actually train people in the process of making discoveries, and in that way point toward the future of discovery by the next generation of physician-scientists, biomedical scientists, and leaders in the biomedical enterprise (Wente, 2015, AAAS, 2015).

CONCLUSION

The prospects of biomedical science that we foresee would hold skilled human resource, a strong financial support and a clear-cut goal for growth, innovation and discoveries. It would have a good balance between supply and demand to foster productivity and quality. At the same time help transition outstanding young people with scientific training into a broad range of careers that can benefit from their abilities and education. If doctoral education is to remain viable in the twenty-first century, universities must establish programs that encourage cross-disciplinary investigation and communication. Universities should develop procedures that foster cooperation that enables them to share faculty members, students and resources, and to efficiently increase educational opportunities and likewise decrease the potential bottleneck. Together those changes will lead to an enterprise that is both more flexible and sustainable. But until that time the perpetuity of science is still a question.

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