Cornell University
ILR School

Cornell University ILR School
DigitalCommons@ILR

Working Papers

ILR Collection

2-24-2006

Doctoral Education and Academic Research (in India)

Arkadev Chatterjea
Cornell University

Satya P. Moulik
Jadavpur University

Follow this and additional works at: http://digitalcommons.ilr.cornell.edu/workingpapers

This Article is brought to you for free and open access by the ILR Collection at DigitalCommons@ILR. It has been accepted for inclusion in Working Papers by an authorized administrator of DigitalCommons@ILR. For more information, please contact jdd10@cornell.edu.

Doctoral Education and Academic Research (in India)

Abstract
[Excerpt] The state of doctoral education and academic research in India is poor and the country has scant representation among the world's great universities. The decline has happened in spite of early achievements. Reasons behind this are complex and defy easy explanations. Several probable causes in terms of resources / facilities / opportunities granted to Ph.D. students, faculty quality, financial resources, academic leadership and other issues are explored and some suggestions for improvement are provided.

Keywords
Research universities, India, PhD students

Comments

Suggested Citation
Chatterjea, A. & Moulik, S. P. (2006). *Doctoral education and academic research (in India)* (CHERI Working Paper #87). Retrieved [insert date], from Cornell University, ILR School site:
http://digitalcommons.ilr.cornell.edu/workingpapers/65/

Required Publisher Statement
Published by the Cornell Higher Education Research Institute, Cornell University.

This article is available at DigitalCommons@ILR: http://digitalcommons.ilr.cornell.edu/workingpapers/65

Doctoral Education and Academic Research (in India)

for The [Oxford] Companion to Economics in India

February 24, 2006

Arkadev Chatterjea, Ph.D. (Cornell)
Professor of Finance & Control Group (On leave, 2004-06) and
Former Chairman of Fellow Programmes and Research Committee,
Indian Institute of Management Calcutta, Kolkata, India
Visiting Fellow & Affiliated Faculty, Cornell Higher Education Research Institute,
Cornell University, USA (2004-06)
[*phone:* 033-2485-8052, *e-mail:* ac286@cornell.edu]

Satya Priya Moulik, Ph.D. (Calcutta), D.Sc. (Calcutta), F.N.A.
INSA Senior Scientist
Professor, Department of Chemistry, Jadavpur University, Kolkata, India
[*Phone:* 033-2414-6411, *e-mail:* cssju@yahoo.co.uk]

The authors thank Ajeyo Banerjee, Nathaniel Sourav Behura, Purandar Bhaduri, Sugato Bhattacharyya, Sandip Bose, Ranes Chakravorty, Sudeshna Maulik Chatterjea, Surjamukhi Chatterjea, Ronald Ehrenberg, Suman Ganguli, Akhil Kumar, Surendra Mansinghka, Indranil Maulik, Avinandan Mukherjee, Mandar Oak, Basudeb Sen and the editor (Kaushik Basu) for helpful comments, discussions, and suggestions. The authors remain responsible for all errors.

Doctoral Education and Academic Research (in India)

1. The Ph.D. and academic research

During graduation ceremonies at many universities in the United States, after doctorate degrees have been conferred upon the candidates, the university's president or the graduate school's dean adds a comment signifying the profession's high calling, like: *"Welcome to the ancient and universal company of scholars,"* or *"Welcome into the society of educated men and women."* The doctorate degree, commonly referred as Ph.D. (Philosophiae Doctor, or, D.Phil., Doctor of Philosophy), is the highest degree. Its primary purpose is training professors and other researchers who would act as recipients and keepers of vast knowledge handed down from the past, creators of new knowledge through research, and disseminators of knowledge through teaching. Former Cornell president Professor Frank Rhodes (2001) opined that "Doctoral education is one of the most important of all tasks of the university because it is the foundation for the nation's research and development enterprise."

What is doctoral education? There is a humorous saying that "In graduate study, you learn more and more about less and less, so that in the limit you know nothing."[1] Jokes aside, Ph.D. requires years of intensely studying and researching in minute detail some area of human knowledge and writing a dissertation based on the findings. *The New Oxford Dictionary of English* (1998) defines "research" as "the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions." Doctoral education is intimately connected with academic research, which is typically conducted in educational institutions. Free from encumbrances that may characterize research done in industry, government agencies, or think tanks, such as pressure to turn a profit, diktat to work on specific subjects or promote a certain ideology, and stricture to meet deadlines, doctoral research is a unique privilege and an extraordinary pursuit. A key to creating wealth of a nation is applied research, which, in turn, traces back to academic research. Advanced nations have powerhouse universities that developing countries try to emulate.

Modern universities have been extremely successful in nurturing and promoting original thinkers. Over seventy five per cent of Fields medallist mathematicians and Nobel Laureate scientists received their Ph.D.s and subsequently worked at universities or institutes with doctoral programmes—excellent programmes attract first-rate professors and Ph.D. students and vice versa. Universities grant money and resources to carry out advanced research, provide a platform for cross pollination of ideas, and act as a beacon that illuminates and guides the nation.

But Ph.D. eludes simple descriptions. Rhodes (2001) characterizes doctoral education as:

---

[1] In the United States and many other countries, bachelor's degree is referred as undergraduate degree, and master's and doctoral degrees are considered graduate degrees. In the United Kingdom, India and most Commonwealth nations, completion of bachelor's degree is considered graduation and studying for master's and doctoral degrees are referred as postgraduate studies.

- *Variable.* Ph.D. is flexible and loosely structured to allow creative student-teacher interaction; the Ph.D. experience varies from institution to institution, department to department, and even from professor to professor.
- *Vulnerable.* Funding depends on diverse sources like government, university, private charity and foundation, industry, and personal resources.
- *Expensive.* Typically students receive stipends and do not pay tuition. Highly educated and trained professors spend long hours supervising student research and dissertation writing. Research equipments and materials tend to be costly.
- *Wasteful.* Many students fail to finish. After wasting lot of time and effort, a research project can come to a dead end.
- *Long lasting.* Ph.D. has longer duration than other degrees—although students at front ranked universities typically finish in four to six years, instances of people taking much longer, even ten to fifteen years, can be found.
- *Ambiguous*. There is considerable disagreement among Ph.D.'s purposes like (1) preparing future university teachers, (2) training for and initiation into the conduct of research, (3) conducting independent research that is a substantial contribution to the general pool of knowledge, and (4) producing "trained minds" to meet the fundamental needs to address the larger issues of contemporary society.

Despite an excellent start, India has squandered the lead and fallen behind in this immensely complex activity. Before discussing the present, we take a bird's eye view of the history of research, higher education and doctoral studies in India.

2. Doctoral education and academic research in India (pre 1947)

Modern academic research in India goes back to 1784 when Sir William Jones established the Asiatic Society of Bengal in Calcutta for promoting oriental studies. But the English rulers primarily set up teaching institutions. And they were mainly interested in applied areas and field sciences like archaeology, botany, geology, trigonometrical survey, and zoology. The greatest academic recognition for such endeavours came in 1902 when Sir Ronald Ross won the Nobel Prize for his work done in India on the life-cycle of malarial parasites.

These efforts spawned the formation of many learned and scientific bodies in India and prepared the ground for doctoral education. A significant development was the establishment of the Indian Association for the Cultivation of Science (IACS) in Calcutta in 1876, whose founder Dr. Mahendra Lal Sircar envisioned an institution for "pure-science learning and science-teaching" with the hope of ultimate success in research. Founded with private funds and government support, IACS organized science lectures, established a library, offered scholarships, created endowed professorships, and set up a laboratory where Sir Chandrasekhara Venkata Raman discovered the "Raman Effect" which won him Asia's first science Nobel Prize. Elsewhere, beginning in late nineteenth century, Sir Jagadis Chunder Bose and Sir Prafulla Chandra Ray conducted internationally recognized research work as professors at Calcutta's Presidency College.

Asia's first modern universities were established in 1857 in Calcutta, Bombay, and Madras. Modelled after the University of London, they were set up as affiliating

universities that merely conducted examinations and granted degrees to students who were taught at affiliated colleges. Changes began under Sir Asutosh Mookerjee, dynamic Vice Chancellor of the University of Calcutta. He declared in the 1907 convocation address, "From now on the University is not just an institution issuing certificates, nor is it even a conglomeration of colleges … This will be a centre of learning and the expansion of the frontiers of knowledge. This is precisely the true ideal of the university" [See Bose (1964)]. Sir Asutosh started departments for postgraduate study in various disciplines and his lead was quickly followed by other universities.[2] He raised funds to create new chairs and hired many outstanding professors in diverse fields from different parts of India including Raman who simultaneously did research work at the IACS. Mookerjee supported M.Sc. graduates in their endeavour to teach postgraduate classes. This group included Satyendra Nath Bose of Bose-Einstein Statistics fame and after whom fundamental particle "bosons" are named, Meghnad Saha who developed "Saha Ionization Equation" and renowned radio physicist Sisir Mitra. All of them became Fellows of the Royal Society (FRS) of England and Saha and Mitra were among the earliest doctorates of Indian universities, receiving their D.Sc. (Doctor of Science) degrees from the University of Calcutta in 1918 and 1919 respectively.

As a professor, hands-on researcher, and mentor, Raman attracted and trained talented students who went on to become distinguished scientists. In the 1917 Indian Science Congress Meetings, he observed that "a real school of physics has grown up in Calcutta the like of which does not exist in any other Indian University and which even now will not compare very unfavourably with those existing in European and American Universities" [See Ghatak et al (1976)].

Many other distinguished European and Indian scientists working in India were elected FRS. This list includes Prof. Homi J. Bhabha (Physicist, Indian Institute of Science (IISc) Bangalore; later founded Tata Institute of Fundamental Research in Bombay with J. R. D. Tata's help; became chairman of Indian Atomic Energy Commission), Sir Shanti Swarup Bhatnagar (Chemist, University of Punjab; later became Director of Council of Scientific and Industrial Research), Sir J. C. Bose (Physicist/Botanist; later founded Bose Institute in Calcutta), Sir Alfred G. Bourne (Zoologist, University of Madras, IISc Bangalore), Sir K. S. Krishnan (Physicist, IACS, University of Dacca; later became Director of National Physical Laboratory), Prof. Prasantha C. Mahalanobis (Statistician, Presidency College Calcutta; later founded Indian Statistical Institute), Prof. Panchanan Maheshwari (Botanist, Universities of Dacca and Delhi; D.Sc. from University of Allahabad,), Mr. Srinivas Ramanujan (Mathematician, University of Cambridge), Prof. Birbal Sahni (Botanist, University of Lucknow), and Sir John L. Simonsen (Chemistry, Presidency College Madras; he and Prof. P. S. MacMahon were instrumental in the establishment of the Indian Science Congress Association in 1914).[3] Many talented academicians including classical scholars, social scientists, geographers, historians, linguists, musicologists, philosophers, and experts in other branches of knowledge, attained name and fame for their scholarly work.

---

[2] However, until 1915, India had only five universities—Universities of Calcutta, Bombay, Madras, Punjab and Allahabad.

[3] Ramanujan died soon after returning to India and consequently did not get opportunity to train students. The above list focuses on scientists in India and excludes Raman's nephew Nobel Laureate physicist Professor S. Chandrasekhar who spent his entire academic career in UK and USA.

This was a great start. There was a small but active group of outstanding academics in colonial India, who did world class research and published articles in world's leading academic journals. They attracted and trained doctoral students. They founded and nurtured institutions which became reputed centres of advanced research. Moreover, some of them moved from academic to applied research and gave leadership to government's research laboratories. With professors, students, institutions, institution builders, learned bodies, even some culture of donating money towards education, and an evolving tradition of quality research work, India established a huge lead in doctoral education and academic research over other Asian nations except Japan. However, India got lost in a quagmire and we next explore this sad story.

3. Doctoral education and academic research in India (post 1947)

Independent India saw a rapid expansion in education. Many institutions with relatively narrower research and teaching interests were set up with the aim of making them centres of excellence. These include the "Indian Institutes" [including the renowned institutes of technology (IITs) and management (IIMs)], the "National Institutes" [which even includes an institute of homeopathy!] and many others. Number of conventional universities also grew. As of 2006, India has 277 university-level institutions (including 60 deemed universities); of these, 171 are conventional universities (including 32 institutions for specialized studies in various disciplines), 37 institutions provide education in agriculture, 38 engineering and technical institutions, 1 for journalism, 4 for law, 16 for health sciences and 10 are considered open universities.[4] Many of these institutions support advanced research and train doctoral students. Table 1 shows the breakdown by discipline of total number of doctorates granted in India during 2000-01 and 2001-02.[5]

Degree granting in India is regulated by the University Grants Commission (UGC), which was established in 1953 by an act of the parliament. The UGC has twin responsibilities: "that of providing funds and that of coordination, determination and maintenance of standards in institutions of higher education."[6] Prof. Amrik Singh opined (2004) that Indian universities had more autonomy at the time of independence; moreover, in the second capacity, no other federal country gives a single agency more power over the universities. He also notes that the UGC has no strategy for handling Ph.D. education and has left it largely untouched.

There are two approaches to doctoral studies in India: (1) the British-influenced Ph.D., which is prevalent in many Commonwealth universities where doctoral students start doing research from the beginning and (2) the American-influenced Ph.D., which is gaining ground in Indian institutes, where students take courses in general and special areas, pass appropriate qualifying examinations, and then start research and thesis writing. The first approach often leads to poorly trained Ph.D.s who study on a part-time basis while working full time in other jobs. However, UGC is discouraging this practice

---

[4] Retrieved from Association of Indian Universities website http://www.aiuweb.org/publication.htm on 26 January 2006.

[5] Retrieved from the University Grants Commission website http://www.ugc.ac.in/ on 26 January 2006.

[6] Ibid.

by granting scholarships to doctoral students so that they can focus on full time research. Moreover, students become over-dependent on their Ph.D. supervisors and it becomes hard to change advisors even in cases of breakdown in relationships. By contrast, the second approach helps students build a trail of record indicating progress, which reduces their vulnerability to the idiosyncrasies of a single professor.

Independent India had significant success in diverse areas like crop development, space programme, and nuclear research. It boasts of a large number of research labs and educational institutions and one of the world's largest academic and scientific communities. Yet, India does poorly in terms of quality of academic research.[7] For example, consider the "Academic Ranking of World Universities" (ARWU), which has been compiled by the Institute of Higher Education at Shanghai Jiao Tong University.[8] The originators created them "to find out the gap between Chinese universities and world-class universities, particularly in aspects of academic or research performance." They developed a composite index based on several indicators of academic or research performance, including Nobel laureates and Fields medallists, highly cited researchers, articles published in *Nature* and *Science*, articles in Science Citation Index-expanded and Social Science Citation Index, and academic performance per faculty. Table 2 reports performance of selective nations in terms of this index. Unfortunately, India has no universities among world's top 300 universities, one (IISc Bangalore) among 301 to 400, and two universities (IIT Kharagpur and the University of Calcutta) among 401 to 500. India occupies a lowly 33rd rank among all countries and 8th among Asia-Pacific nations. Moreover, IISc has moved down from a rank among 201 to 300 that it held in 2003 and 2004. The results indicate a general failure of Indian universities to do high quality academic research and train Ph.D. students.

Next, we propose some probable causes for this decline and explore some possible remedies.[9]

---

[7] A proper understanding of this would require an examination of publications in top ranked journals and an evaluation of all books and monographs written by every India-based academic in all fields of study. Due to lack of time and resources to do such a study, we rely heavily on ARWU rankings that are discussed below.

[8] See http://ed.sjtu.edu.cn/en/index.htm for the rankings and a discussion of the methodology. Notice that their index is heavily biased towards the sciences and does not adequately represent many areas of humanities where book writing is an indication of academic scholarship.

[9] There are other studies like the 2005 *Times Higher Education Supplement* (THES) ranking of world universities, which ranks IIT as 50th, IIM as 84th and Jawaharlal Nehru University as 192nd in the world. Unlike ARWU rankings which heavily focus on high quality academic research, THES rankings rely on highly subjective indicators like Peer Review Score (40 per cent weight based on a survey of international academics who name "top universities in the subject areas and the geographical regions in which they have expertise" and so on) and Recruiter Review (10 per cent weight), objective but non-academic indicators like Percentage of International Staff (5 per cent) and Student (5 per cent), Faculty-Student Ratio (20 per cent), and a research-correlated indicator (with no control for quality) Citations per Faculty (20 per cent) THES rankings should please China because many Chinese universities are ranked much higher by this index than by their own ARWU rankings; for example, Peking University was ranked 15th by THES (above Tokyo, Chicago and Columbia universities) but between 203-300 by ARWU; Fudan University moved up from 195th in 2004 to 72nd in 2005 by THES but was ranked between 301-400 by ARWU in 2005. (Retrieved from THES website http://www.thes.co.uk/worldrankings/ on 31 January 2006).

4. Probable causes of poor performance and some possible remedies

Developing and leading topflight universities is a highly complex activity that eludes simple descriptions and easy generalizations. Hence, we begin with a cautious discussion of what is made available to Indian Ph.D. students and then explore faculty situation, money problems, poor academic leadership, and some other factors that we believe are preventing Indian universities and institutes from realizing their fullest potential.

(1) *Resources, facilities, and opportunities granted to doctoral students.* Table 3 compares this for Ph.D. students at the world's best programmes, typically located in the United States, with those at elite Indian universities and institutes.

The table suggests that the main difference between American and Indian doctoral students lie in academic opportunities and other factors do not appear to be binding. However, Ph.D. students at world's finest universities get excellent academic opportunities and exhibit quality performance not just because they are at great universities but because they have been culled from all corners of the globe through a keenly competitive process. Like many other nations, India faces the "brain-drain" problem. Instead of staying stuck in serene mediocrity, Indian institutions should make efforts to attract high quality Ph.D. students from India and other nations.

(2) *The faculty*. Before 1947, most Indian academics worked in India. In 2006, by contrast, an overwhelming majority of top and medium level Indian academics are employed at foreign universities. Of course, there were many distinguished academics who studied abroad, came back, and built a successful career in independent India. But many more would have returned if the situation was conducive.

Reasons behind this migration are complex and multifarious. Commonly cited probable causes like poor academic environment, dearth of academic resources, low salary (compared to a person's potential global salary after purchasing power adjustments; stagnation vis-à-vis industry salaries), same salary regardless of academic quality, dearth of graduate students and potential collaborators of high academic calibre, need to be carefully examined and appropriately remedied.

India has no concrete plans for luring the faculty back. Instead, it has been progressively made harder for expatriates to return:[10] (1) since late 1970s, India does not recognize medical qualifications acquired in the UK or the US because they don't recognize Indian qualifications; this "patriotism" argument raises the hurdle for talented doctors and medical school professors contemplating return, (2) only Indian citizens can work for the government (exceptions are rare), which makes it difficult for expatriates who have adopted other citizenships to come back and work at premier universities and institutes, a majority of which are government supported, and (3) returnees were exempted from paying Indian taxes on foreign sourced income for nine years; since 2003, the Indian government suddenly reduced this period to two years, making it expensive for

[10] See Chatterjea (2004) for a discussion of these issues.

potential returnees who have accumulated a nest egg abroad or would like to supplement a relatively meagre Indian salary by teaching, doing research or consulting abroad.[11, 12]

Other Asian countries are taking active steps to build great universities:

- Realizing that they cannot pay their professors "world-market" salaries, Israel grants them generous leave of absence to spend time abroad and even hold concurrent positions at US and European universities. Israeli doctoral students get less actual hours but spend more "quality time" with their professors and greatly benefit from academic networks their mentors maintain with overseas support. Basically, others are subsidizing Israeli universities and helping them excel. The results have been excellent—Israel has retained world renowned scholars, won three Nobel Prizes in the last two years, and Israeli Ph.D.s teach at some of the world's best universities.
- Top ranked Asian universities seriously encourage high quality research publications and even offer cash rewards for papers accepted in world class journals.
- *The New York Times* has reported that China wants to transform "its top universities into the world's best within a decade."[13] China has made a remarkable expansion of education in last ten years. The model is simple: "Recruit top foreign-trained Chinese and Chinese-American specialists, set them up in well-equipped labs, surround them with the brightest students and give them tremendous leeway. In a minority of cases, they receive American-style pay; in others, they are lured by the cost of living, generous housing and the laboratories. How many have come is unclear." Hong Kong (part of China), Singapore, Taiwan are strengthening their universities by making similar efforts.

Removing harmful restrictions and supporting high quality researchers is a precondition for improving Indian educational institutions.

(3) *Financial resources.* It is expensive to attract, retain, and nurture scholars.[14] In the U.S., it typically costs $500,000 to support an assistant professor and $1 million to support a full professor in the laboratory sciences—the costs include faculty salary, Ph.D. student and post doctoral researcher stipends, price of chemicals and samples, cost of machines and equipments, cost of laboratory space, expenditures for conference attendance, journal subscriptions, and so on. It is costly to add buildings, research labs, lecture halls, and campus facilities for academic work.[15] China sharply increased

---

[11] A typical US based medical/business/law/engineering school professor will make less than 10% of their existing salary in India and will surrender lifetime employment for a job that requires retirement at the age of 62 years.

[12] Newly enacted "dual citizenship" programme for expatriates (Non-Resident Indians or NRIs) and their offsprings (Persons of Indian Origin or PIOs) is a "citizenship" without the rights to vote, run for constitutional office and hold government jobs. It will not solve any of these problems.

[13] See "China Luring Foreign Scholars to Make Its Universities Great" in the *New York Times* dated 28 October 2005.

[14] See Ehrenberg (2002) for a discussion of different factors that contribute to rising costs of higher education.

[15] India spends significant amounts on building faculty and staff quarters. Such expenses are either absent or form an insignificant part of total expenditure of U.S. universities.

expenditure on higher education and spent more than Rs. 46,000 crores in 2003. India spent a paltry Rs. 1,748.37 crores on higher education during 2002-03, which is less than five per cent of the Chinese amount.[16] Resource starved Indian institutions need more money.

(4) *Academic leadership.* Heads of top ranked U.S. universities are extraordinarily talented individuals who typically possess high academic distinctions, leadership skills, pleasing personality, fundraising ability, strong prior administrative record, and a long list of other accomplishments; political appointments are rare. Moreover, a search committee carefully scrutinizes the records and interviews potential candidates. By contrast, leaders of Indian institutions tend to lack such talent, are exempted from extensive scrutiny and often end up being political appointments. Consequently, the academic leaders at U.S. institutions are much more successful in raising money, far more likely to support and uphold academic research and seek and retain good scholars than their Indian counterparts. India needs considerable improvement in this regard.

(5) *Other issues.* Many other characteristics like the board structure, internal governance structure, incentive system, and academic values separate the finest universities from the rest. A major characteristic of top ranked U.S. universities is their competitiveness—they vigorously compete for faculty, students, industry support, private donation, government funding, alumni resources, recognition, and many other dimensions. A talented faculty may be attracted by carefully creating a package that may include higher salary, lower teaching load, support for Ph.D. students, generous research budget and facilities, creation of an academic centre to support research, good office location, spousal job opportunities, help in locating housing, opportunity to build the department, and so on.

Education experts tend to agree that incentives do matter and the American philosophy of academic governance is a major factor in explaining the high quality of U.S. universities. Countries like China, Singapore, and Taiwan are incorporating many of these features and strengthening their institutions. But education policymaking in independent India is yet to demonstrate familiarity with the complex issues that underlie highest level academics and have failed to build great research universities and institutes.

5. Conclusion

The state of doctoral education and academic research in India is poor and the country has scant representation among the world's great universities. The decline has happened in spite of early achievements. Reasons behind this are complex and defy easy explanations. Several probable causes in terms of resources / facilities / opportunities granted to Ph.D. students, faculty quality, financial resources, academic leadership and other issues are explored and some suggestions for improvement are provided.

---

[16] Retrieved from http://indiabudget.nic.in/ub2003-04/eb/sbe57.pdf on 26 January 2006.

References

Bose, Satyendra Nath, 1964. *The Problem of Education in Bengal and Asutosh*, in Chatterjee, Santimay et al. (edited), 1994. *S N Bose: The Man and His Work; Part II: Life, Lectures and Addresses, Miscellaneous Pieces.* S N Bose National Centre for Basic Sciences, Calcutta, India.

Chatterjea, Arkadev, 2004. Two Roots and Little Else. *The Telegraph*, Ananda Bazar Patrika Private Limited, Kolkata, India.

Ehrenberg, Ronald G., 2002. *Tuition Rising: Why College Cost So Much*. Harvard University Press, Cambridge, Massachusetts, USA.

Ghatak, U. R. (Chairman, Publication sub-committee), S. C. Mukherjee, A. K. Chaudhuri, S. B. Banerjee, S. N. Bhattacharya, S. P. Ghosh, and M. N. Bagchi (Secretary), July 1976. *Indian Association for the Cultivation of Science: A Century*. Published by the Indian Association for the Cultivation of Science, Printed at Sree Saraswaty Press Ltd., Calcutta, India.

Rhodes, Frank H. T., 2001. *The Creation of the Future*. Cornell University Press, Ithaca, New York, USA.

Singh, Amrik, 2004. *Fifty Years of Higher Education in India: The Role of the University Grants Commission*. Sage Publications, New Delhi, India.

List of Abbreviations

ARWU Academic Ranking of World Universities
D.Phil., Doctor of Philosophy
D.Sc. Doctor of Science
FRS Fellow of the Royal Society
IACS Indian Association for the Cultivation of Science
IIM Indian Institute of Management
IISc Indian Institute of Science
IIT Indian Institute of Technology
NRIs Non-Resident Indians
Ph.D. Philosophiae Doctor
PIOs Persons of Indian Origin
THES Times Higher Education Supplement
UGC University Grants Commission

Table 1 Faculty-wise number of doctorate degrees awarded during 2000-01 and 2001-02

Faculty	No. of Doctorate Degrees Awarded	
	2000-01	**2001-02****
Arts	4,398	4,545
Science	3,727	4,012
Commerce/Management	621	704
Education	399	427
Engineering/Technology	778	747
Medicine	221	192
Agriculture	889	781
Veterinary Science	110	90
Law	105	108
Others*	296	293
Total	11,534	11,899

Source: University Grant Commission (UGC)

* Others includes Music/Fine Arts, Library Science, Physical Education, Journalism, Social Work, etc.
** Provisional

Table 2 Selective country-wise statistics of number of universities ranked among globally high ranked universities (based on ARWU 2005)

Rank	Country	Top 20	Top 100	Top 200	Top 300	Top 400	Top 500
1	USA	17	53	90	119	140	168
2	UK	2	11	19	30	36	40
3	Japan	1	5	9	13	24	34
4	Germany		5	16	23	33	40
5	Canada		4	8	17	19	23
6	France		4	8	13	19	21
7	Sweden		4	5	9	11	11
8	Switzerland		3	6	6	7	8
9	Netherlands		2	7	9	11	12
10	Australia		2	6	9	10	14
12	Israel		1	4	4	6	7
17	Russia		1	1	1	2	2
19	China			2	6	15	18
21	South Korea			1	2	5	8
23	Singapore			1	1	2	2
25	New Zealand				1	2	5
33	India					1	3
35	Turkey						2

Source: Academic Ranking of World Universities 2005 (ARWU 2005), Institute of Higher Education, Shanghai Jiao Tong University (http://ed.sjtu.edu.cn/ranking.htm)

Table 3 A comparison of resources / facilities / opportunities granted to US and Indian Ph.D. students at elite universities and institutes

Resources / facilities / opportunities	Ph.D. students at US universities	Ph.D. students at Indian universities and institutes
Faculty	World renowned scholars willing to take Ph.D. students under their wings and nurture their research careers.	Dearth of scholarly faculty limits quality research and publication. Consequently, publication in low quality journals is the trend to increase numbers count.
Seminar series	Regular, high quality seminar series.	Most institutions lack regular research seminars.
Conferences	Easy to attend world class conferences but hard to get papers accepted in them.	Conferences in India generally have low academic standards.
Access to journal editors	Easy access to editors and associate editors of major journals (may include student's mentors) who give comments, edit, and help improve student's paper attain the right standards.	Indian students rarely have such access, which makes it harder to publish in major journals.
Computing facilities and library resources	World class computing facilities and library resources.	Excellent by Asian standards but lags behind world standard. JSTOR and many publishing companies have made it easier to access journal articles through the internet.
Support from government and industry	Strong tradition of sponsorship and support from government and industry.	Little interaction with industry. Government is the main source of support for most Ph.D. students.
Internships and training	Easier to get internships at international institutions (International Monetary Fund, World Bank, …) and government agencies (Federal Reserve Bank, Securities and Exchange Commission, …) with high quality research staff.	Indian students rarely get internships at internationally renowned institutions; no tradition of taking interns at central and state government agencies.[17]
Work opportunities	Work opportunities at colleges, research institutes, and universities throughout the world.	Work opportunities at Indian institutions.

[17] Recently, some undergraduate students at IITs are going to European universities and research centres for summer internship.

Stipend	Most students get free or subsidized tuition. Monthly stipend varies by "market value" of disciplines. Average stipend around $1,500 per month, is roughly one-third of a typical assistant professor salary.	Monthly stipend of Rs. 10,000 to Rs. 12,000 along with free tuition and other benefits like contingency fund, free/ subsidised housing and so on. Monthly stipend is about half of an assistant professor salary.
Time for reading, research and writing	Fellowship holders have much more free time than students who support themselves as Teaching Assistants (TAs) or Research Assistants (RAs) who typically work 15 to 20 hours per week.	Most students hold fellowships these days and have free time for studying and preparing themselves for advanced learning. Part time students (whose intake is currently restricted) hold regular jobs and are hard pressed for time.