Society for Scientific Values

Ethics in Scientific Research Development and Management

News And Views

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V.P. Chest Institute
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Editorial Board

Main objectives of the 'Society for Scientific Values

1. To promote objectivity, integrity and ethical values in pursuit of scientific research, education and management, and
2. To discourage the unethical acts in these areas

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Editorial

The issue of News and Views comes in a new format this time, incorporating national and global news concerning ethical breaches committed by persons in the field of Science & Technology. Society for Scientific Values (SSV) has been tirelessly pursuing its role not only as a watchdog but also in investigating some of the cases and ensuring implementation of proper action. The number of such cases which are brought into the notice of SSV or the scientific community are mainly the high profile cases having high impact value in the society, but it may only be the tip of the iceberg. Some plagiarism cases concerning Indian academics have been discussed in widely circulated and highly respected journal like Science. Such incidents damage the image and credibility and put a question mark on the integrity of Indian scientific community. As Indian science and its achievements need global recognition, such incidents do harm us all in an indirect manner. Need for personal recognition, career growth, funding, peer pressure all seem to be contributing to such unethical practices in science. Dr. K. R. Rao, in his article in Current Science (Vol.94, No.5, 10 March 2008, pp 581-586) has highlighted about the menace and suggested ways to detect and avoid plagiarism. To minimize scientific dishonesty and inculcate good scientific practices, work towards ethical awareness has to be done at the grassroot level of students as well as at the highest level of controlling authority. To increase such awareness, incorporating a course on scientific ethics in school/ college level seems to be a necessity. Workshops/seminars need to be organized at research institutes to propagate such values and consequences of breaching the ethical boundary.

This issue also contains the views of eminent scientists and practitioners of scientific values in a variety of relevant topics. The Paintal memorial lecture, annually organized by SSV, has been delivered by Prof. V.K. Gaur this year and the lecture is included in this issue for all the readers of News and Views.

It is felt that all the members of SSV and the readers of News and Views believe in the objectives of SSV and its relevance in today's ever expanding world of scientific workers. As all actions ethical/unethical originate in the mind, it is time to act in the line of the famous three monkeys –

Do not be dishonest, do not tolerate dishonesty and do not forgive dishonesty.

— P.N. Tiwari
Santa Chawla

SSV Activity Highlights in the Current Period

Some cases of misconduct

Prof. Ranjit Singh, Director, Netaji Subhash Institute of Technology (NSIT) was removed from his post by Board of Governors on 23/09/2008. Cases of plagiarism, financial irregularities and unfair appointments were investigated against him in which SSV played a major role. On SSV's request, the Principal Secretary, Delhi State Govt indicated that the case of misconduct was placed before the institute's Board of Governors who finally took the action.

CIMAP, Lucknow Director Dr. Khanuja resigned from the Directorship as he was implicated in cases of plagiarism. SSV took an active role in the case.

- Prof. Kalyan Kumar, Director, NERIST, Meghalaya has been suspended from his position for plagiarisation of research publications. Instead of the inquiry committee (which included SSV representative) as proposed by the highcourt, the state government has set up one man committee of the Director, IIT Guwahati. His report is awaited. Reminders have been sent to the Director for an early action.
- Prof. Mathur, TIFR has been charged with plagiarism. A TIFR committee has verified the charge and the institute has issued a warning to Prof Mathur
- **IEEE/Publications decision on the appeal of Prof. Karmeshu to investigate his work plagiarized by Dr. D. Kouvatsos:**

In January 2008, Prof. Karmeshu a former EC member of SSV and a Bhatnagar award winning scientist from the School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi, reported the case of suspected plagiarism of his research paper by Prof. Kouvatsos and Assi from the Department of Computing, School of Informatics, University of Bradford, UK. The paper by Karmeshu and Shachi Sharma titled "Long Tail Behavior of Queue Lengths in Broadband Networks: Tsallis Entropy Framework" was submitted to the journal Performance Evaluation in July 2005 (PEVA05 paper). This paper was rejected after about 14 months, but later they found that substantial portions of their PEVA05 paper have been published in another paper titled "On the Analysis of Queues with Long Range Dependent Traffic: An Extended Maximum Entropy Approach" by Kouvatsos and Assi in "IEEE Proceedings, Conference on Next Generation Internet Networks, 3rd EuroNGI Conference, 21-23 May 2007" (IEEE07 paper). The IEEE07 paper by Kouvatsos and Assi contained atleast 23 instances

identical in language, equations and graphs with those of the PEVA05 paper. Also, 11 out of 17 references cited by Kouvatsos and Assi were the same as in the PEVA05 paper. Following Prof. Karmeshu's complaint, the Chief Editor of PEVA, Dr. Werner Bux, confirmed that Dr. Kouvatsos was indeed one of the referees of the PEVA05 and that his conduct as a referee was found unworthy and unacceptable and dropped him as a referee for the journal with immediate effect. Karmeshu and Shachi Sharma also reported the matter to IEEE, which had published the paper by Kouvatsos and Assi. This matter has been referred to the Manager Intellectual Property Rights, IEEE and was under their consideration. They have also reported the matter and findings of Dr. Bux to the Vice Chancellor, University of Bradford, UK where Dr. Kouvatsos works as Professor in Department of Computing, School of Informatics. Prof Karmeshu's complaint to IEEE has been investigated by its IPR committee and has accepted that the paper of Kouvatsos and Assi in the IEEE proceedings has partial similarity to the unpublished manuscript of Prof. Karmeshu. However, identifying this partial similarity was level 3 misconduct as per its PSBP manual, the IEEE has allowed the plagiarised paper to remain and only banned Kouvatsos from publishing in any of the IEEE publications for a period of one year. Prof. Karmeshu has represented to the IEEE against this decision, as it did not offer any relief to him and his paper continues to remain unpublished. The decision of the committee is given below:

"The adhoc committee has determined that the insufficient attribution in the paper by Dr. Kouvatsos was not done deliberately, but was the result of a poorly edited revision of an earlier paper that had used and attributed your (Prof. Kameshu) work. In light of this, the committee has recommended that the prohibition of publication be lifted from Dr. Kouvatsos. In order to attribute any material in this paper that is your work, a Notice of Violation will be added to the paper with a credit to you. If you can post the paper online and provide a link to the unpublished text, we will include the link to your paper on the Notice".

SSV EC was disappointed with the earlier IEEE response, which upheld the complaint of Prof Karmeshu but gave a very mild punishment to Prof. Kouvatsos (UK) by prohibiting him from publishing any paper in any of the IEEE journals for a limited period. But the latest decision of IEEE revoking even this mild punishment comes as a rude shock. It defies logic as to how IEEE can accept Kouvatsu's "use" or "attribution" of Karmeshu's unpublished work without his permission in any version whatsoever, deliberate or otherwise. It is very surprising that IEEE ignored not only the main issue of plagiarism by a reviewer from an unpublished manuscript, but also ignored that Kouvatsu is also guilty of breach of trust (and confidentiality) as a reviewer of Karmeshu's manuscript, for which he has since been removed by the editor who assigned him the manuscript for review. It is obvious that the latest decision of IEEE does not do any justice to the complainant, as the plagiarized paper of Kouvatsu continues to remain published under IEEE and the original paper of Prof. Karmeshu continues to

remain unpublished. The offer of "notice of violation" only adds insult to injury, as it requires that Karmeshu first publishes his manuscript, which he cannot do as long as its plagiarized version remains published and not withdrawn by IEEE. SSV appealed to the IEEE management to re-examine the whole case properly and seriously consider withdrawing the plagiarized manuscript and avoid allegations of celebrity justice.

- Prof. R. Singh, IISC (previously from Gurukul Kangri Univ, Haridwar) has been charged with plagiarism of a paper published by Dr Goddard of Germany. The case is being investigated by Prof. Chandrasekaharan of IISc. Based on the available evidence, it seems to be a clear case of plagiarism.

- Prof. S.C. Mishra, IITG (formerly a PhD student of IITK) has been accused of plagiarism by Dr David Blank, a former visiting faculty of IIT-Kanpur and IIT-Kharagpur, presently heading a private company in Mussouri. Prof. Mishra has in turn accused Dr. Blank of forgery. Both have filed cases against each other in the high courts in Guwahati and Mussouri, respectively. The cases were examined in details by the President, SSV at the request of both the sides. Since merit of the two cases was difficult to decide without a very elaborate investigation, the President, SSV advised both sides to withdraw the court cases and adopt a "forgive and forget" policy. Both sides welcomed the advice and have gratefully acknowledged the role of SSV in resolving the matter amicably.

- Mr. Rait, Profs. M.C. Bhatnagar, P.C. Mathur, Sengupta and Kumar of Electronics department in the South Campus, DU have published essentially the same paper in Solar Energy Materials & Solar Cells (SOLMAT) and Physics (E) Journals. They submitted yet another paper in Thin Solid Films (TSF) recently. Elsevier used its software to check on possible plagiarisation. Convinced, with a clear case of plagiarism the TSF journal has rejected the paper. The acknowledgement of the fraud by Mr. S.S. Rait (a Ph.D. student), the corresponding author to one of the Associate Editors dealing with this paper is indeed shocking. President, SSV has written to the VC, DU and also to the Director, South DU Campus that this case of fraud and unethical practice is shameful and disgraceful for a prestigious university and should be investigated. Both as an associate editor of SOLMAT and President of Society for Scientific Values, Prof. Chopra is very concerned about such unethical practices taking place increasingly in India. Regrettably, no report of any action taken on the issue has been communicated to SSV so far.

- Prof. Satish Ogale was removed from his position several years ago by the Pune University on charges of moral turpitude. He left the country and served in a university in USA. He has now come back to India and has

been awarded prestigious Ramanujam fellowship and a senior scientist position in NCL, Pune and several high value research projects by various S&T agencies. Some NCL scientists have protested against the "unethical" rehabilitation of Prof. Ogale and have requested SSV to investigate the case.The President, SSV informed the EC that Prof. Ogale is a good scientist and thus his rehabilitation is in the interest of the country. Nevertheless, it is unfortunate that DST and CSIR have set a poor example by not keeping in mind his past unethical/ immoral conduct before awarding the most prestigious fellowship of the country. The EC decided that our observation be placed on our website to make a point that SSV expects the government agencies to uphold ethical values in the pursuit of science and technology.

- In the plagiarism case involving Dr. N. Krishnan, Professor and Head, Centre for Information Technology and Engineering, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, SSV discussed all the available evidence and the response of the accused. It is clear that he has made false claims regarding his publications, including papers that were originally published by others, as well as publications in journals that did not exist at that time. His co-authors have also disowned those papers and say that they did not publish them. If all this information is available with the VC, Chancellor of MS University and Governor of Tamilnadu (apparently it is), SSV expects them to reach a similar conclusion and take exemplary action to deter plagiarism.

- Ph.D. Thesis scam of Jadavpur University, Kolkata revealed "plagiarism in its worst form" involving doctoral thesis of two students Mr Subhamoy Singha Roy and Mr Samit Pahari both belonging to Department of Instrumentation Engineering and both conferred Ph.D. degree by the University. According to the enquiry report by a university committee, "chapters 1 to 12 (pages 1 to 328) in the theses of Mr Singha Roy and chapters 1 to 12 (pages 1 to 328) in the thesis of Mr Pahari are identical except for the "headers" that appear in the thesis of Mr Singha Roy". The case came up for hearing before Mr Justice Sanjib Banerjee of Calcutta High Court on 11th April, 2008. In his 48-page judgment, Mr Justice Banerjee said that "it would be open to the university to begin the process afresh or otherwise adopt a procedure to assess the matter by affording adequate opportunity to the petitioner to present and urge his defence. Nothing in this judgment should be read as having in any manner exonerated the petitioner of the charge of plagiarism or any of the shades of it."

Compiled by
— Santa Chawla

News pertinent to SSV's cause

Global

There have been reports in reputed journals like Nature and Science about cases of scientific misconduct and ethical breaches. In a report published in Nature in 2005 (http://www.nature.com/physics/highlights/7044-1.html) Meredith Wadman revealed that one in three scientists (in a survey of thousands) in US confessed misconduct involving faking results to dropping suspect data points. Main reasons for such misconduct were reported to be increasing pressure to publish for getting research funds. The president, Federation of American Societies of experimental biology said that as the defining criteria adopted by US government are 'Fabrication, Falsification and Plagiarism', it is beyond the purview of government to investigate or punish any conduct that does not fall within such definition.

A recent article in Nature (Vol.453/19, June 2008, pp980-982) reporting results of a survey indicate that only few cases amongst many are reported and investigated by the Office of Research Integrity (ORI). Since it is very difficult for any regulatory body to monitor and catch cases of misconduct in various research organizations, it is suggested that primary deterrent must be at the institutional level. As only high profile cases come under scrutiny, many cases involving low impact may go unnoticed. Since the reputation of the institution is at stake, whistle blowing and the protection of whistleblower is an issue which needs to be addressed. In such a case, a sacked whistleblower from the University of Nevada in Reno, demanded reinstatement of job (Nature, vol. 453/8, May 2008).

In Nature breaking news (Nature, vol. 454, 2008, pp 917-018), the scandal at medical university Innsbruck, Austria regarding clinical trial of stem cell therapy for urinary incontinence published in the Lancet medical journal was reported to have serious ethical and procedural problems. In a reply, the president and secretary general of the Austrian academy of sciences clarified (Nature, vol. 455/ 2, October 2008, pp589-590) that the case was under investigation and the academy is in no way "involved in any political moves that might promote scientific misconduct and corrupt the scientific community". Subsequently 'Austrian ethics watchdog launched' (Nature 456, Dec. 2008, pp557) declared the formation of an Agency for scientific integrity – first of its kind in Austria.

Committee on Publication Ethics (COPE)

"The **Committee on Publication Ethics** (COPE) is a charity registered in the UK. It is concerned with the integrity of peer-reviewed publications in science, particularly biomedicine. It was established in 1997 and meets in London but its

over 5200 members are from all continents. Its membership is composed mostly of Editors-in-Chief of scientific journals, with some other companies and individuals who are interested in publication ethics as Associate Members. Indeed, some publishers (Elsevier, Wiley–Blackwell, Springer, Taylor & Francis and the BMJ Publishing Group) have signed up their entire catalogue of journal titles as COPE members.

COPE provides a forum for publishers and Editors of scientific journals to discuss issues relating to the integrity of the work submitted to or published in their journals, both print and online. Examples include conflicts of interest, falsification and fabrication of data, plagiarism, unethical experimentation, inadequate subject consent and authorship disputes. It encourages its members to seek investigation into suggested miscondcut by the employing universities, hospitals or other funders of prima facie cases.

The COPE Forum, open to all members, meets quarterly to discuss cases and posts its advice on how to handle the matter on this website, where summaries of all cases can be found, most with the resulting outcome. Its governing body, the COPE Council, also meets quarterly: members include Editors, writers, publishers, ethicists and lawyers, among others. It has appointed an Ombudsman to deal with disputes between COPE members or between them and the organisation. It also publishes a Code of Conduct for Editors who are members of the organisation and will investigate complaints against them. It provides, freely, flowcharts on how to handle the more common publication misconduct problems.

COPE also funds research on issues relating to publication misconduct, will be publishing a newsletter and its officers lecture widely on the subject, making their presentations available to members. COPE organises annual seminars in the UK and has plans for similar events in the USA from 2009. COPE is committed to improving Editors' abilities to deal with publication misconduct and is developing an online distance-learning course to do so. COPE has also provided its members with an auditing tool for their journals to measure compliance with its Best Practice Guidelines.

It helps fund the UK Panel for Research Integrity, its chairman sitting on the board and made a major contribution to the First World Conference on Research Integrity in Lisbon, 2007. COPE intends to contribute further to the Second World Conference on Research Integrity in 2010 by running workshops for South-East Asian Editors. It also has links with the Council of Science Editors in the USA and the World Association of Medical Editors, as well as other groups related to its cause. You can read more about COPE's history here."

Code of conduct as defined by COPE is available at www.publicationethics.org/codeofconduct

As given in the homepage of COPE

National

- Dr. Pushpa Bhargava has been nominated as a representative of the Supreme Court of India to the Genetic Engineering Assessment Committee (GEAC) of the Union ministry of environment. The court is currently hearing a case against GM crops, as a part of which the government's regulatory mechanism through GEAC has come into scrutiny. SSV supports total transparency in regulation and recommends full public disclosure of all the data submitted for GEAC's approval for independent verification. SSV will watch the developments in regulatory ethics with concern.
- BHU, Varanasi & DCE, Delhi have requested SSV to organize Seminars in the institutions to sensitize students and faculty members. The President will coordinate the activity.
- In articles written in Current Science about plagiarism menace, Dr. K. R. Rao (Current Science Vol.94, No.5, 10 March 2008, pp 581-586) and Prof. S. Mahadevan (Ibid, p553) have mentioned the tools to detect plagiarism using a database called *Déjà vu* (http://spore.swmed.edu/dejavu) and citation matching tool named *eTBLAST* (http://invention.swmed.edu/etblast).
- SSV notes with concern the recently published controversies in vaccine production and adoption in India, highlighting lack of evidence-based or science-based policy, as well as alleged corruption and mismanagement to the disadvantage of the public sector and the advantage of private sector. Therefore, SSV resolves to support and join a Public Interest Litigation being contemplated by medical experts, public heath experts and activists, with the help of Human Rights Law Network.

As the following article indicates, over 80 per cent of children who undergo clinical trials do not survive in India and it seems that AIIMS is as much involved in this infanticide as any other place. If all this is true, the decline of ethics in Indian science has gone to far dangerous levels than the authorship and plagiarism issues that have been the primary preoccupation of SSV.

"A DEADLY BUSINESS

Wednesday, November 26, 2008 08:00 IST
P A Francis

Last week the Drug Controller General of India suspended yet another drug trial in the country after the death of an infant. The victim was undergoing trial of an advanced pneumonia vaccine of Wyeth in a Bangalore hospital in violation of the country's weak clinical research rules. The child had a pre existing cardiac disorder and should not have been included in the trial. According to DCGI, the investigator of the vaccine did not adhere to inclusion-exclusion criteria, a standard protocol to be followed by pharmaceutical companies and CROs while conducting human trials. Wyeth was permitted to do trials only on healthy babies. The trial, began last year, was being conducted on 350 healthy babies who were between 42 and 72 days old. About 250 have already been tested and Wyeth is still allowed to collect the data. Only in last August, another instance of death of 49 infants reported while conducting clinical trials at All India Institute of Medical sciences, New Delhi. The report was based on the facts provided in response to a Right To Information query raised by one of the Delhi based NGOs. AIIMS admitted that in all, 4142 babies were enrolled for clinical trials by the Institute's department of paediatrics since January 1, 2006 and out of that 2728 were below the age of one. As per the government records, as many as 700 human trials for various new drugs are going on in the country today. Out of this, 10 per cent are paediatric trials involving babies, infants and adolescents. Some senior investigators involved in the trials privately admit that over 80 per cent of children who undergo trials do not survive in India.

Such high rate of fatality in human trials is known only to the investigators, CROs and to the companies on whose behalf these trials are being conducted. Even DCGI and ICMR come to know about deaths and injuries during trials much later. In the case of paediatric trials, the parents of the children are usually poor and are kept in dark about the cause of death. They are made to believe that death is caused on account of some pre existing diseases of the child and not because of adverse reactions of the drug under trial. In the case of Wyeth trial, what has happened was the total neglect of the inclusion exclusion criteria by the investigator. The ethics committee was not aware of such violation at the site. The primary objective of having an ethics committee at a trial site is to monitor the trial and the subjects. As is the case with most of trial sites, the ethics committee at the Bangalore hospital also has been ineffective. Now, the issue before India's regulatory authorities is how to stop the recurrence of such violations or lapses of clinical research rules on the part of CROs and pharma companies.

The whole process of recruitment of subjects, taking informed consents, compensation to subjects, etc. has to be made adequately transparent. The office of DCGI needs to be strengthened to detect such illegalities and take stringent and timely action against the offenders. Establishing a separate cell in the office of DCGI to monitor the functioning of ethics committees at trial sites could be one step."

Conference/ Workshop on Ethics in Science

Hamburg conference

An international workshop was held at University of Hamburg during 15 -17 October 2008 on '**Teaching ethics and peace to science and engineering students'.** The themes covered in the workshop was mainly "Sharing experience in teaching ethics and peace to students of science and engineering', 'Structural approaches for integration into bachelor and master programs and summer schools' and 'Connection between education and practice'. Papers in very relevant issues like 'What students should know about Whistleblowing - the Responsibility of Scientists and Engineers for the Design of Progress' was also discussed.

New Delhi Symposium

- **A National Symposium** on **Ethics of Science** was organized at Jamia Milia Islamia University, New Delhi during 20-22 December, 2008. The themes discussed were "**Ethics of science**: The Contemporary context:(what, why and wherefore?), **Decision-making on science impacted social issues** (R & D Directions, Knowledge bases, Legal Frameworks, Environment for Critical Evaluation, safeguards against uncritical use of Expert advice, quality of expert advisories etc.), **Uncompromising Committment To Excellence**: An insurance against the spread of unethical culture(ingredients, challenges, institutional/ systemic structures, in-built ostracism etc.). SSV took an active part in the symposium.

The Paintal memorial lecture, 2008 of SSV was delivered by Prof. V. K. Gaur on 21st December, 2008 during the symposium on Ethics of Science

Since the inception, Paintal memorial lecture has been organized annually by SSV and delivered by the following eminent scientists:

- **Prof. M. G. K. Menon, Former President INSA**
- **Dr. R. A. Mashelkar, Former DG, CSIR**
- **Dr. Deepak Pental, VC, Delhi University.**

- **Session on Nano-ethics in International Conference on Magnetic Materials & their Applications for 21st century [MMA 21] -2008**

An International Conference was held during Oct. 21- 23, 2008 at National Physical Laboratory, New Delhi under auspices of Magnetic Society of India. MMA 21 was organized under the chairmanship of Dr. Vikram Kumar and Dr. R. K. Kotnala was the convener of the conference. Two hundred fifty three scientists, engineers & students from eight countries participated in the conference. One technical session was devoted to 'Nanoethics' and was chaired by Prof. K. L. Chopra. The purpose of the session was to sensitize researchers for ethical values while professing nanoscience and nanotechnology.

Compiled by
Santa Chawla

Letter to the Editor

Some thoughts on Higher Education in India

The articles by Professors P.N. Tiwari, Sisir K. Sen and Andre Beteille in the March 2008 issue of SSV on various maladies of higher education in India are indeed very forthright and thought provoking albeit they only speak of the obvious. Perhaps such observations have become too obvious and natural for we Indians and our managers of education to take any notice of. How else can one explain steady deterioration of ethics and standard in education in spite of so much of understanding and wisdom available at higher levels as exemplified by the learned articles cited above.

The root cause of the sickness, which education in this country suffers from, is the brazen feudal arrogance of power in education irrespective of whether a politician or a bureaucrat or an academic wields it. Professor Sen in absolutely right in his diagnosis. Arrogance and education never go together both physically and spiritually. As ill luck would have it, politicians, in the States and the Center, more often than not, are at best ”college passmen” but hardly educated. Indian Bureaucracy, an outdated medieval institution, has been ministering the politicians' whims. Underneath these two tiers, lies the third tier of academics as Chairmen, Directors and Vice-Chancellors etc. As has been clearly pointed out by Prof. Beteille, those ”academics” who can do rounds of various ministers/ministries, secretaries/departments fill up the third tier. The servility of such people fit the arrogance and inefficiency of the men at upper two tiers better and thus , not only do they survive but also rise, ala the natural law of ”survival of the fittest”. This ”triveni sangam” of self- serving, inefficient and corrupt trinity - politicians, bureaucrats and academics - is enough to destroy quality, autonomy, creativity or any other sought-after aspects of good education. This phenomenon, interestingly, has a”scale-invariance” associated with it operating with very high efficiency at all levels in all sectors of state machinery. This provides a glaring example of ”bad money(men) driving good money(men) out of circulation”. The omens for the future are written on the walls.

Professor Srivastava has lamented about the practice of interviewing the Vice-Chancellorial candidates. But there are more maladies associated with V.C. selections as one finds in Orissan example. As reported in press, interested persons seemingly ”applied” without a proper open advertisement for the V.C.

positions, through private communications as it were. The committees entrusted with the task of recommending names of three persons regularly include bureaucrats as chair-men or members for past several years perhaps to make it known to one and all that V.C. should sub serve the supremacy of the political and bureaucratic bosses. The academician members of the committee, one suspects, are suitably chosen to sign on the dotted lines or are incapable of judging biodata or both. Thus, biodata of men selected as V.C. many a time provide little evidence of (a) excellence in educational records,(b) high standard of continuous research in terms of publications in peer-reviewed journals with impact factors or genuine post-doctoral research stints in institutions of national and international repute or (c) academic administration. Such selections, to a high degree of probability, are perhaps,"fixed" by the tripartite agreement talked about earlier. The so-called Selection Committees only provide a legal stamp to the illegitimate motifs. If appointment of Chairmen, V.C.s and Directors are "fixed" through such dubious methods, God forbid, who will take care of the noble objectives of academic institutions ! Even the highest academic bodies like UGC and AICTE seem to be opening their doors to the academic businessmen, a new Indian class arising out of privatization of education, instead of pure academics.

But this is our emergent "shining India", our "Bharat Mahan". We only have to cry for our beloved land, if we so wish. And watch the great Indian show from the sidelines and enjoy, again if we so wish. For, as things stand now, there seems to be no way to stem the rot. Considering the dismal performance on the parts of many State Governments vis a vis the Centre, a partial answer, on which a consensus may be difficult to arrive at, could be to take education to central list in lieu of being kept in the concurrent list. A better answer, however, is always welcome.

Lambodar Prasad Singh
Professor, Physics Department,
Utkal University, Vanivihar, Bhubaneswar

Paintal Memorial Lecture, 2008

Ethics of Science

Vinod K Gaur
Indian Institute of Astrophysics, Bangalore
e-mail: vgaur@iiap.res.in

The title phrase is simple enough to evoke a host of significant issues of our contemporary concern: privacy rights, autonomy of the embryo, saviour siblings, doctored school curricula, to name a few. However, an attempt to explore a framework wherein these may be posited meaningfully exposes the need to explain what the phrase means, without which it may appear a contradiction in terms. Equally necessary to this exercise is the spelling out of plausible premises to provide the elements of the framework. Further, it is necessary to recognize that a language constrains the expression of thought, and the words used in the title are necessarily associated with their Greek origins in the sense that although they may share many of the attributes of their synonyms in other languages, the latter may often have nuances that would escape being captured in the arguments advanced here.

Early Greek philosophy laid great stress on abstraction of the *ideal* from the world of phenomena to provide a reference for comprehending their bewildering variety. The five aspects of mental and social processes which they thus idealized to become the cornerstone of their philosophy were: Ethics-the ideal conduct; Aesthetics, the ideal form, or beauty; Politics, the ideal social organization; Logic, the ideal way of reasoning; and Metaphysics, the study of the ultimate reality and the nature of 'mind' and 'matter', through perception and knowledge (epistemology). Various societies down the ages have dealt with the formulation of ethical principles guided by the perception of good and evil. Some of these are indeed shared by many, and may be regarded as 'universals'. Besides these, however, many cultures have their specific brands of ethical precepts some of which would clearly be regarded as 'unethical' by contemporary society. The Athenians practiced slavery alongside their unwieldy democracy, and the Indians

This is the Paintal Memorial lecture of 2008, delivered by Prof. V. K. Gaur, during the National Symposium on Ethics of Science on December 21, 2008 held at Jamia Milia Islamia University, New Delhi.

have yet to completely eradicate the grotesque caste practices after more than half a century of a flourishing democracy. The first of the western society to give women voting rights was New Zealand in 1893. In Britain it did not happen until 1918 and in Saudi Arabia, it still does not exist. Ethical values are thus both universal and relativistic as one would expect from any 'extra-logical' formulations, howsoever noble their motivating intentions.

Science too has a well understood meaning as the body of formulated knowledge gained through a hypothesis formulation – experiment design – deduction process, without any claim to its absolute representation of 'reality'. It is therefore, intrinsically tentative, forever straining creative human faculties towards discovering the 'truth'. This tendency furnishes science with a self cleansing mechanism. The pertinent question to my mind is, therefore, not whether Science sui-generis, has any Ethics which is difficult to conceive, but what new ethical issues arise from the ever advanced products of scientific knowledge and its applications in our daily lives and our social organization, and whether in the '*legitimate'* practice of science, there reside some insightful premises for creating a framework for predicating ethical values. The word 'science' in the title is, accordingly, used here to include such implicit values, if any, as well as the implications of its new emerging knowledge products to and their impacts on society.

I believe that there are indeed some values logically derivable from the epistemology of science and its praxis, which together with other moral values of our contemporary society could furnish a dependable framework for evaluating ethical issues. The first value derivable from the pursuit of science is '*straining towards the truth*'. It stems from the innate curiosity of the human spirit to comprehend the nature of the physical world and its persevering urge towards perfecting this knowledge through the process of hypotheses formulation and validation by discriminating design of thought or physical experiments. Thus, a system of knowledge is built as a long polymerized chain of tautologies that illuminate a wondrous world, and are linked together by bonds of logical reasoning. Since a single error somewhere in this long chain has the potential of corrupting subsequent elements in its organization, there is a subliminally learned value by practitioners of science, barring the unscrupulous, of bearing a collective responsibility for maintaining its purity. This attribute translates itself in the second *value,* of *truth telling* by reporting the results of scientific investigations with uncompromising fidelity and their approaches and interpretations with such transparency that would enable these to be scrutinized for their validity and, in the fullness of time, corrected or supplanted by more valid knowledge by other independent individuals or groups. This enjoined practice constitutes the long- term self correcting mechanism of science, so that aberrations that may have been

inadvertently or unscrupulously introduced, are destined to be identified and expelled. Meanwhile, the best standing ideas of the time are avowedly held as being *tentative*, subject to change and modification in the future, even as society may use it to serve its purposes in the way it chooses.

Other *values* follow as a corollary, from the imperatives of a relentless march towards enhancing the reliability of extant knowledge through scrutiny by the most critical minds. The very modes of making new consequential knowledge available through peer reviewed published results with the insistence that these are strenuously validated and furnished with all pertinent references to authors of earlier results, albeit susceptible to abuse, ensure that their results could be checked independently, and credits are rendered to the rightful. In turn, this argues that *unfettered access* to the products of science are regarded as *sacred commons*, free from the prejudices of class, caste, age, gender or social position of the person seeking to engage with it. This underlines the inalienable *democratic value* of the scientific enterprise and its characteristic mottos of 'criticism' and *independence of judgment*. Indeed, it has further implications as to the explicit maintenance in the scientific enterprise of alternative spaces for the formulation and testing of new ideas even though they may appear heretical to the reigning paradigm. What greater assurance is needed to assert that both *doctrinal* and *hierarchical* structures are *antithetical* to the sustenance of the very life breath of Science, and a society which fails to thus fashion its socio-technological systems, has little possibility of making enduring contributions to scientific advance.

Lest, however, it be construed that I limit the evaluation criteria for ethical values of a scientific enterprise only to the values derivable from its praxis and products, I must hasten to add that one must indeed bring to bear the implications and imperatives of other ethical judgments predicated by our sense of fair play, notably of *beneficence, non-malfeasance*, and *equity*. For, the application and impact of new knowledge on society and the pertinent ethical values are both played out in the public domain. Practitioners of science and their agents who mediate this interaction are susceptible to the prevailing ethical ambience of society including such apparently *legitimized* elements as the driving principle of *profit*, creating dilemmas vis a vis the aforesaid values of science. From the growing list of technology induced social problems such as environmental degradation and endemic diseases, and the yet unexamined threats to social values from advancing research frontiers of genetically modified food, regenerative medicine, and new chemicals and materials, to name a few, it is difficult to escape the conclusion that contemporary society is unwittingly mortgaging its future when the accumulated liabilities of hasty and uncritical applications of new knowledge may prove too painful to resolve. This highlights one of the *prime ethical issues*

of our science driven society. I believe that a constructive approach would be to squarely recognize its seriousness and then go on to creating robust mechanisms for continual appraisal and desirable steering of the critical ongoing socio-technological processes as ordained by the *values of science*. In respect of newer technological products and systems, the institution of open, scientifically sound, non-authoritarian mechanisms for their evaluation, enlightened by public discussions, would help evolve judicious policies for their infusion and framing of appropriate laws for their regulation, wherever necessary.

I must also hasten to aver that society does need new science to help empower it with effective approaches to confront the new emerging future challenges of which there are several serious ones that already loom large. There is today a strong consensus that some definitive instrumentally recorded data as well as rapid environmental changes such as the drastic reduction of the arctic ice cover, cannot be explained by considering these changes to be a piece of the natural variability of the climate system. Specifically, the projected global warming in the coming decades has, according to our present prognostic capabilities, the potential to grievously reduce the availability of water and food grains which could prove disastrous for a populous country such as India. Potentially, we could reduce this threat by judicious use of knowledge tempered by the *values* expressed in the foregoing arguments. The question is: Will we?

In a low technology environment, such as prevails in most of the developing world, infused with the trappings of high technology products and systems, the above prescription raises *three* other important questions related to the quality*, reliability and integrity* of possible appraisal mechanisms. This is not too infrequently manifested in this country, in the unseemly wrangles between independent laboratories and those that are publicly funded, about analytical results such as for example of the percentage of toxic substances in various market products of wide public consumption. This *deficit* in the quality of investigative procedures even with the employment of imported analytical systems, is more than matched by deficit in the *quality of expertise*, as eloquently expressed in the Environmental Assessment reports, among other advisory documents, which become the basis of numerous governmental decisions resulting in regrettable administrative actions, such as for example the outcome of an inadequately considered forest management policy. Finally, instances are not uncommon where expert opinions are willfully doctored by suppressing the margins of uncertainty which is a most critical attribute of measurement, to buttress authoritarian belief systems, such as for example the exaggerated age of the exhumed coastal artifacts off the Gujarat coast, declared by a government department.

Finally, I put forward the view for criticism and the enlightenment that may follow, that an *important condition* for the existence of those intellectual traits that have the greatest possibility of countering the potential hazards implicit in the uncritical adoption of new knowledge products and systems, is a *deeply nourished non- hierarchical science culture in our society*. I believe that this would have a high probability of leading to other desirable social traits which characterize the serious minded pursuit of science, spawning in its wake imaginative and novel ways of comprehending knowledge and wielding it towards an inclusive spread of *beneficence, non-malfeasance*, and *equity*. I further believe that in such an ambience of science, the competitive urges would have less proclivity for departing from the *inalienable values* of science, which condition breeds dishonour to its creed through such acts as blatant plagiarism or the more tolerated prevalence of a vast exercise that is full of sound and fury signifying very little.

Ethical Issues in Science and Technology

K. L. Chopra
President, Society for Scientific Values
(Former Director, I I T, Kharagpur)

Ethics is a science of morals, or a set of principles with a sense of purpose. .Ethics are fundamental to the civilization of any society. Starting from the dawn of civilization with hunter gatherers, ethical norms and standards have evolved in different civilizations, cultures and societies at different times, with a profound influence of culture, religion, spiritual and philosophical beliefs. Ethics are relative, not absolute ; some having converged to a core principle of a secular and commonsense- value code of conduct have become universal and fundamental to humanity . Beyond the fundamental ethics, there are others such as personal ethics based on individual's beliefs, interpersonal ethics developed between individuals or groups of individuals, societal ethics evolved between groups of individuals of different societies/cultures/religions/profession , professional ethics based on the practice of a particular profession, and regulatory ethics for regulating professional ethics .The earliest known example of a code of ethics is the Hippocratic Oath for medical profession which was created during the 3rd century BC and continues to be administered even today world over, testifying to its relevance to the profession. Professional ethics continue to evolve with changing social ecologies but are specific to a profession as practiced in a particular environment.

Paradigmatic shifts have taken place as a result of the industrial revolution leading to the evolution and definition of ethical values and codes of conduct in business , management, scientific , engineering and other professional activities in the industrialized western world. Such ethics have gradually been adopted as an integral part of teaching-learning process in schools of management all over the world**.** Scientists and engineers are expected to apply science and technology for progress and prosperity of society at large. They interface with society in a multidimensional way, depending on their role as a teacher, professional worker or a manager. Consequently, it is paramount for them to imbibe professional ethics. It is equally important to make sure that professional education also imparts such ethics to the students aiming at knowledge-based professional careers.

This is the extended abstract of the talk delivered by Prof. K. L. Chopra, President, SSV in the National Symposium on Ethics of Science on December 20, 2008 held at Jamia Milia Islamia University, New Delhi.

Today, knowledge is the engine of growth and is the driving force behind rapidly changing, shifting and emerging paradigms in a globalised professional scientific and engineering environment of knowledge. Knowledge is now a multidimensional creativity/innovation in sciences (including social sciences), engineering, technologies, manufacturing, marketing, management, etc. The evolving tech-nomic-globalisation demands adherence to internationally acceptable ethical values and code of conduct. It is , therefore, essential for academic institutions to develop the mindset of science and engineering students to cultivate a sense of social responsibility to uphold the honour and dignity of the profession in a global environment.

Ethical issues and responsibilities relate to functions of an individual in different professional environments of a student, teacher, professional, consultant, entrepreneur, manager or industrialist. At personal level, issues are fundamental in nature and relate to such desirable characteristic as high levels of integrity and honesty, wisdom, loyalty, fairness, impartiality, trustworthiness, reliability, courage, compassion, humility, divinity, love and being not submissive observer or remaining indifferent to wrong happenings. In an academic environ, ethical issues relate to scientific values, scientific temper, research integrity, and scientific misconduct. Besides issues related to scientific misconduct in the form of plagiarism, duplicate or recycled publications, quality and integrity of data, there are other ethical dimensions such as : transparency, accountability, quality of peer review, author credit, intellectual property rights, awards and rewards, conflict of interest, quality of research supervision, recruitment and assessment, sharing of R&D facilities, concern for sustainability and ecology, interaction with public and media, policy matters, regional, communal and caste factors, political interventions, corruption, antiquated governance and rules of management, whistle blower's role and fate, etc**.**

Science is ethics-neutral but scientist-engineer and technology are not. Technology is a double-edged sword with useful and harmful sides. Science and engineering professionals develop products and processes for manufacturing using minimal energy and natural resources to minimize cost. No development is, however, possible without affecting our natural resources, ecology and bio-sphere. Dwindling energy resources, reaching limits of the carrying capacity of our ecosphere, and global warming are some of the warning signals to all global societies. As a result, typical examples of such ethical concern in India are:

- Whether genetically modified (GM) plants, seeds, fruits and food should be allowed in India to serve and feed a billion people
- Whether CNG or unleaded petrol is a better fuel for our massive transport needs

- Whether aquaculture industry should be allowed in coastal areas
- Whether this or that polluting industry should be closed

A professional scientist or technologist is expected to contribute to the progress and well-being of society in a sustainable environment through creation and dissemination of knowledge, and by using scientific knowledge and skills to develop technologies , products and services, as also regulatory mechanisms, etc consistent with an accepted ethical code of conduct. A professional faces a whole variety of new issues which depend on position, and cultural/ religious environment. These include:

- Adherence to the code of conduct prescribed for the profession by a related agency
- Regard for cultural values, traditions and practices in the work place
- Nurturing of harmonious work culture among coworkers, monitoring and assessment, awards and rewards
- Mentoring for excellence and leadership roles
- Adherence to the standards of safety, concern for safe practices at workplace, protection of life from risks, hazards, injury, stress and illness
- Protection of environment, adoption of sustainable and green engineering practices, proper maintenance and servicing
- Concern for conflict of interest with one-self, employer, clients, or friends, cross-cultures
- Protection of intellectual property rights, transfer and commercialization of technologies etc.
- Avoidance of favoritism and victimization in recruitments and promotions, grants, awards, peer reviews
- Elimination of feudal work culture, sycophancy, regionalism, & casteism
- De-bureaucratization of the management system with transparency and accountability
- Elimination of corruption for money and power

Finally, let us remember that "history of the world civilizations shows that societies have risen to a higher level not through mechanical or technological efficiencies but by practicing sound moral and ethical values" (Quoted from Gita & Management by Swami Bodhinanda)

Plagiarism and Misconduct in Indian Science: High Time to Act

N. Raghuram
School of Biotechnology, GGS Indraprastha University, Delhi, India.
e-mail: raghuram98@hotmail.com
web: www.ipu.ac.in/usbt/btraghu.htm

This article is an extended version of an earlier "opinion" article published on SciDevNet:http://www.scidev.net/en/opinions/we-must-restore-scientific-integrity-in-indian-res.html

The recent case of plagiarism in India involving the publications of P. Chiranjeevi (1), a Professor of Chemistry from Sri Venkateswara University, Tirupati, has once again highlighted the need to address misconduct in Indian science comprehensively. Out of 66 papers published by him and his students/ co-authors during the period 2004-2007, many were found by his university enquiry panel to be based on "unethical and fraud practices in publishing research papers. Some parts of his research work were found to be fake". Amidst retractions of dozens of these papers by reputed international publishers like Elsevier and Springer, the university authorities stopped him from doing any further research and denied him pay rises and administrative positions. While one may debate why the university peers and authorities did not smell a rat in his prolific publications till they heard from an Indian abroad, whether the action taken is commensurate with the crime, or whether the concerned journals established the charge in each of the retracted papers, the fact remains that there was a response to an obvious problem along expected lines. It is certainly laudable to that extent, as are a few other punished cases from other Indian universities and research institutes in the last few years.

However, as most Indian scientists know, the response to misconduct in Indian science has been neither uniform nor consistent across levels and institutions. In the absence of clearly defined policies and mechanisms, employers generally deal with misconduct complaints as it suits their convenience, hence the inconsistencies. A cursory glance at the list of cases reported on the website of the Society for Scientific Values (SSV, an independent watchdog of concerned Indian scientists, www.scientificvalues.org/cases.html), reveals that majority of the cases involve people from well endowed institutions, indicating that misconduct is not an exclusive domain of the underdogs. In fact, when the accused are directors, director-generals, vice-chancellors, national awardees, presidents of

national academies etc., a system of celebrity justice prevails. Therefore, the problem is not only that misconduct occurs, but also that the consequence of it depends on which side of the power equation one belongs. This was best brought out by the SSV investigation of the Kundu case, in which an official enquiry panel of seven Bhatnagar Prize awardees (the most prestigious national award for scientists in India) favoured the exoneration of Dr. Gopal Kundu, another Bhatnagar awardee, from the charge of fraudulent publication, even though the paper (2) was eventually retracted by the Journal of Biological Chemistry (USA) based on its own investigation.

The above case is also listed on the SSV website and continues to be debated in the best-known Indian fortnightly journal, Current Science. More recently, its associate editor wrote "During the past two–three years, I must have detected more than some 80 cases of plagiarism in various articles submitted for publication in *Current Science*. When I use the term 'plagiarism', I use it in a rather broad and loose sense, not distinguishing among copying, misrepresentation, etc. or their finer distinctions. I find that this practice is not merely confined to students, but is prevalent amongst many researchers and science writers in this country….Plagiarism is rampant in the 'General Articles' and 'Review Articles' categories with regard to *Current Science*." (3). This revelation, as well as the growing number of cases being handled by the SSV clearly indicate that plagiarism and misconduct is a growing problem in India, contrary to the recent statement of the Scientific Advisor to the Cabinet (of the Indian Prime Minister) in his reaction to the Chiranjeevi case (1).

In fact, no rigorous survey has ever been attempted to quantify the nature, extent and growth of plagiarism or misconduct in Indian science. Therefore, we also do not know how much public money is wasted on unreliable scientific outputs, which age groups or professional levels produce them the most, what motivates them to do so, how many get away, whether it is a failure or collusion of mentors, how far does training or awareness help, what are the carrots for honesty or the sticks for dishonesty, who suffers the most due to the misconduct of scientists/ technologists, is the general public safe from the roles they play in regulatory decisions regarding drugs, foods, beverages, environmental testing, crops, etc., what proportion of employers encourage credible complaints and protect whistle blowers, how many employers ensure fair and objective investigations and most of all, what proportion of the guilty are punished commensurately and consistently to ensure the credibility of the whole system.

Outright plagiarism, or plain copying, is among the easiest forms of misconduct to detect (there are softwares for it now), establish, deter or punish. It also often makes most of the noise and news, but does very little fundamental

harm to the body of knowledge *per se*, except for some redundancy. In fact, given the way our international science publishing and peer review system works at present with Mathew effect and what not, one can argue that it is only the plagiarism of words that is detested; plagiarism of ideas is often encouraged and rewarded. The easiest way to get grants or publish 'honestly' is to work along the lines expected by powerful reviewers, cite them profusely and avoid being too creative or unconventional- especially if one belongs to a developing country or a non-English speaking country.

Other forms of plagiarism such as gift authorship or inappropriate credit (for otherwise original work) are far more prevalent and damaging to the very culture of doing science and yet, most Indian directors, heads of departments and group leaders expect co-authorships from the work of their subordinate colleagues as a matter of right and get away with it, in a system that rewards sycophancy and keeps independent minds at bay. Falsification, fabrication, suppression of negative data etc. are far more dangerous to the progress of science itself, especially because substantial investments and man hours are wasted by others who pursue that line of work before realizing that they were misled. Detecting them is also more difficult and requires elaborate investigative structures, skills, will and time, leaving the ground open for mishandling or even cover up.

None of these problems is unique to Indian science. It is also not that all plagiarism cases in India arise out of Indians copying work done from developed countries abroad. In the last one year, SSV site listed 2 instances of UK scientists plagiarizing Indian work. A third one involving a European group appeared recently in a prestigious US Academy journal, which allowed the plagiarized paper to remain with a citation to the original source. This trend has been practiced by many top journals, especially when the charges involved influential scientists or the complainants involved lesser-known scientists or from developing countries. This trend is not entirely new either, as many Indian scientists still remember how Dr. GN Ramachandran's seminal work on the triple helical structure of collagen was handled by Nature and Francis Crick, over half a century ago. On the other hand, when the accused are underdogs, top journals tend to withdraw their papers unceremoniously, inviting charges of discrimination even when the decision *per se* may have been right in that particular instance. One hopes that the recent efforts by journal editors and publishers to evolve common standards (through international organizations like the Committee for Publishing Ethics, or COPE) for handling cases of misconduct will remove such inconsistencies and ensure fair and equitable treatment.

Even though plagiarism and misconduct in science is a global phenomenon, every nation must do its bit to stem the rot, including India. Firstly,

the Indian government must set up a national body and adopt a national policy to foster research integrity and enact laws to deter misconduct and protect whistle blowers, without waiting for UNESCO or other upcoming international norms. In fact, for a country that is the home of SSV, the first organisation of its kind to be established in the world way back in 1986, symbolising a bottom-up demand for regulating misconduct in science, it is a tragedy that India missed the bus and is now reduced to a follower of other countries that have adopted a top-down approach of regulating misconduct. Secondly, the Indian scientists, academies and professional societies can do a lot at their own level to deter misconduct through mentoring, peer pressure and scientific audit, without waiting for SSV at home or the International Council of Scientific Unions (ICSU) abroad to remind them that laws can only help those who are willing to help themselves. The recent case of Deborah Rice in the US Environment Protection Agency (4) and the highly questionable closure of 3 vaccine manufacturing units of the Indian government (5) highlight that the private industry and their corrupt friends in scientific, administrative and regulatory positions are often better placed than most of us in dealing with inconvenient laws. In such a situation, the silence and inaction of honest scientists will not only invite suspicion and discredit the whole scientific community, but also put scientists at the receiving end of a bureaucratic superstructure that will eventually be run by people who have little to do with science. Thirdly, the reviewers and editors of Indian journals must do their bit to expose plagiarism and fraud and not leave it entirely to the mass media, which are doing an excellent job of reporting misconduct in Indian science. Fourthly, employers need to emphasize not just on the productivity of their employees but also on how it was achieved- after all, ends don't always justify the means. Above all, we must avoid treating misconduct as a taboo and discuss it openly. Till then, the Society for Scientific Values remains the only vanguard in India, whether one likes it or not. In today's world, where many dozens of countries have some formal system in place to qualify, deter, detect and punish misconduct, the credibility of Indian science lies in improving and showcasing how it deals with misconduct, rather than in pushing it under the carpet.

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Need of Ethics in Nanoscience

R.K.Kotnala
National Physical Laboratory, Dr. K. S. Krishnan Road, New Delhi - 110012
e-mail: rkkotnala@nplindia.ernet.in

Ethics is concerned with the conduct of human beings. All scientific activities, including those by the scientists are conducted with the participation of human beings or have an impact on human beings or on the wider society and environment. Therefore, it is essential that scientists/researchers understand ethical issues and the implications of their scientific work and act accordingly. For making ethical judgment, the scientists rely upon various standards of ethics, which could be universal or specific to the culture.

The issues of misconduct in scientific research like fabrication, falsification, plagiarism, credit-not-due, multiplication of publications of the same data, biased awards, unfair promotions etc. are of serious concern today among all developed and developing nations because ethical issues are a global concern for knowledge economics. In recognition of the important role of ethical conduct, most academic and R&D institutions in the developed world have introduced formal and informal studies on ethical values in their curricula and training programmes. Some premier institutions globally have also evolved such courses. Most science & technology based professional societies in developed countries have also adopted appropriate codes of conduct and, in some cases, also Boards of Ethical Review. An office of Research Integrity has also been set up in the US during Clinton Presidency. Documentation of ethical issues is being done by international agencies such as International Committee of Scientific Unions, UNESCO and COMSET.

There has been a steady growth of research in the nanosciences and nanotechnology all over the world in a short span of time. A wide range of research topics and issues including those have the potential to seriously invade the researcher, environment & our health. These are inherited drawbacks associated with practicing nanoscience. Nanoscience ethics to be followed strictly at this time when bioethics are increasingly in demand even though already ethical codes of conduct are in place.

Recently nanotechnologies are widely seen as having huge potential to bring benefits to many areas of research and application. The physical, chemical and biological properties of various nanomaterials differ substantially as do the potential risks they pose. Hundreds of nanotechnology applications in food, water, drugs, cosmetics, sports items, biomedical sciences have already paved the way

and are already in commercial production despite a huge health and safety question mark. Nanoscience and Nanotechnology is emerging in a wide variety of applications, yet unfortunately very little is known about the environmental implications of engineered nanomaterials, of possible ways to handle engineered nano-materials as environmental pollutants, or of how nanomaterials behave in the environment when used for remediation. Therefore, such article will increase awareness of potential problems, but may disappoint those who expect dramatic revelations about nanoparticles as pollutants.

Nanoscience is defined as the study of phenomena and manipulation of materials at atomic scales, where properties differ significantly from those at a larger scale; and nanotechnologies as controlling shape and size at the nanometer scale. It is the study of how materials behave when their dimensions are reduced to the nanoscale. It can also refer to the materials themselves that are used in nanotechnology. A unique aspect of nanoscience is the vastly increased ratio of surface area to volume present in many nanoscale materials which opens new possibilities in surface-based science. Materials reduced to the nanoscale can suddenly show very different properties compared to what they exhibit on a macroscale, enabling unique applications. For instance, inert materials become catalysts (platinum); stable materials turn combustible (aluminum); solids turn into liquids at room temperature (gold). Much of the fascination with nanotechnology stems from these unique quantum and surface phenomena that matter exhibits at the nanoscale.

The advent of nanoscience applications in our life possesses a high risk on our health, some of the examples are:

At sizes less than 100 nanometers, inhaled particles begin to behave more like gas molecules and can be deposited anywhere in the respiratory tract by diffusion. Like gases, simply because of their “nanoscopic” size, can pass through the lungs into the bloodstream and ultimately sucked up by cells, within hours reaching potentially sensitive sites such as bone marrow, liver, kidneys, spleen, and heart.

The complex physical factors such as aerodynamics, gravity, and mass causes the largest inhalable dust particles to deposit primarily in the nose and throat. Any toxic effects occur at that site (for example, nasal cancers due to wood dust). Smaller particles are deposited in upper airways and are expelled by the “mucosociliary escalator;” the fingerlike cilia and the mucous lining of the trachea and bronchial tubes, which together move particles up into the throat and nose, where they are coughed, sneezed, blown out, or swallowed.

The next smallest particles penetrate deeper into the alveolar region, where

oxygen and carbon dioxide are exchanged in and out of the blood and are usually cleared when alveolar macrophages (special monocytic scavenger cells in the lungs) engulf the particles and carry them away. Toxic effects are usually due to killing of the macrophages, which causes chronic inflammation that damages lung tissue, asbestosis and silicosis are its glaring example. As particles become small compared to the size of a cell, they can begin to interact with the molecular machinery of the cell.

Bulk carbon in macroscopic components is medically useful because it is not poisonous to or rejected by the body. Yet, some researchers have observed from experiments that carbon nanotubes (especially single-walled or multi-walled carbon nanotubes) seem to be more toxic than other forms of carbon. Others have debated that claim because the nanotubes used had trace impurities of iron or solvents. In similar debates over other engineered nanomaterials, may be the purity of the engineered nanomaterials. At this stage, people don't have absolutely repeatable control on manufacturing processes; nanotech production is relatively low yield of reliable production. Thus, buckyball products from one supplier are not necessarily identical to those from another, so toxicity may differ.

In "Nanowatch" column in *The Ecologist*, Thomas points out that the first ever scientific conference on nano-toxicity, Nanotox 2004, [1]. He lists "Ten toxic warnings" including NASA research in 2003 showing nano-tubes produce a more toxic response in rats than quartz dust and claims by top UK toxicopathologist Vyvyan Howard that that nano-particles can cross the blood-brain barrier in humans and gold nano-particles can move across the placenta from mother to fetus. According to Vyvyan Howard, nanoparticle toxicity is more related to their size than to the material from which they are made; while the reduction in size confers a variety of interesting and potentially profitable properties to substances, it can also confer unforeseen toxic properties. And they have high mobility not just within the body but getting into the body, by ingestion, inhalation or absorption through the skin [2]. Gold usually considered inert, it is highly reactive at the nano-scale. Similarly, titanium dioxide, one of the most commonly used substances in nanotechnology. Generally considered a relatively benign "nuisance dust" in normal industrial uses, it may have far more worrying properties in its nano applications. Hundreds of nanotechnology applications are already in commercial production despite a huge health and safety question mark. Industries and safety authorities admit their ignorance on the subject and expect guidance on safety aspects.

Keeping in mind the immediate and long-term interests of the larger sections of people and the autonomy of researchers this article has been written to apprise importance of nanoscience, in brief its risk and hazards. So that one can think of ethical issues involved in this rapid up coming science area,

indiscriminately. At the moment, need of the hour is to make nanoscience ethics an integral part of the planning and methodology of research, and to enable organizations and individuals to develop appropriate mechanisms for ethical self regulation. Besides this, some of the principles to govern ethical issues in nanoscience must be improved on researchers as guidelines. Such guidelines to be framed may not resolve all ethical problems and dilemmas, which may confront researchers. For each dilemma and conflict they face, researchers may be required to balance the demands made by moral principles of research.

Proposed Ethical Principles/Codes For Nanoscience Research

The basis for ethics in research based on moral principles and essentially must adhered to such as:

i. Research is a social activity, carried out for the benefit of society. It should be undertaken with the motive of maximization of public interest and social justice.

ii. Research should also make a positive contribution towards the welfare of people.

iii. Research must not cause harm to the participants in particular and to people in general.

iv. The benefits & risks of research should be fairly distributed among people.

v. Research must respect and protect the rights and dignity of researchers.

vi. All persons and organizations connected to research should make adequate efforts to make research outcomes public in appropriate manner from time to time. Most crucial step in nanoscience research is to disclose relevant results of it and implications of completed research must be elaborated along with its uses.

vii. Institutions should ensure that research records are preserved for a reasonable period of time. Also, the conduct of research must be fair, honest and transparent.

viii. Nanoscience research carries to a large extent risk to the participants and to society. Taking adequate precautions and minimizing and mitigating risk is, therefore,essential.

ix. Researchers must have a responsibility towards the interests of those involved in or affected by their own work. They should make reasonable efforts to anticipate and guard against possible misuse and undesirable

or harmful consequences of research.

x. Peer review should be an essential part of research endeavour or initiative in nanoscience, and should be sought at various stages of research by weighing its risk and hazard to human health.

xi. In ethical sense editors and publishers of a journal must ensure that nanoscience based research articles should mention drawbacks/risks of the work alongwith its applications.

xii. Funding authority and sponsors of such research project should respect the ethical guidelines for research and should not expect researchers and institutions to undertake research or conduct it in any way contrary to the ethical guidelines.

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P.K. Nagar
B. 21/115-10A, Batuk Dham Colony, Kamachha, Varanasi 221 010
e-mail: nagar_pk2001@yahoo.co.uk

At various forums in this country enough discussion has started for upgrading scientific culture yet in its comparison no serious efforts have taken up and at times it is considered a wasteful expenditure. Many complaints have come that the country lacks excellent scientific manpower while scientists demand that preparation and evaluation of projects should be done by renowned subject matter specialists. It has often been observed that due to administrative hindrances many projects get stuck up in files and if a project is sanctioned after 1-2 years it looses its scientific and global importance. To set priorities in the field of S&T, to screen out good researchers, to allot funds, and to select heads in scientific institutions are some of the decisions taken generally by science managers/ administrators which causes a lot of frustration among scientific community especially younger lots who want to fulfill 'crazy ideas'. A thinking has set in among them that many scientific institutions lack a healthy scientific environment for preparing excellent brigade of researchers. A healthy scientific environment is one which is free from prejudices, bureaucratic formalities, dishonesty, false claims, nepotism, sycophancy and fluttering, drum beating etc. It is a common and regular complain among the scientific community that an administrator can not judge their needs and an administrator thinks that scientists are not of any special category but now this types of charges and counter charges are at their last stage.

Recently, Government of India has decided to set up 'Science and Engineering Research Board' (SERB). As soon as parliament passes the bill it will come in force. The board will promote S&T and frontier areas of research of international standard and can sanction up to Rs75 crores as a research grant and also to provide necessary infrastructure. Further, the board will have same significance as national science foundations of many developed countries. It is expected that the board with the initial capital of Rs 1100 crores will give a new direction and dimension to S&T. It is an urgent need of our scientists that they should decide top priorities considering the local relevance and global competition. Like equality and social justice our constitution makers have strongly emphasized to develop scientific temperament among youths. In recent years not only there is deterioration in scientific research but our youth has less inclination towards science. For e.g. if we examine critically the plant scientists, while analyzing the

recent concepts in tissue culture they forget to correlate their data with concepts of plant growth substances.

It is not for granted that once SERB comes into existence all the problems related to S&T would be solved. Prof. C.N.R. Rao Scientific Advisor to Prime Minister of India has expressed the opinion that 'Science is on the death bed in India'. He has expressed deep concern over the deteriorating condition of scientific teaching and research in this country (*Hindustan Times*). If it is true there is an urgent need to remove this impression and to uplift the status for syllabus of S&T. There is no dearth of scientific talents in the country and given proper atmosphere and opportunities they may become 'bright spots'. A ray of hope is there from the board to lift the standard by removing apprehension 'who is best.' However, if SERB starts giving priorities only to big projects to selected groups and enroll itself in red tapism, it will clearly behave like a administrator whom a real scientist always rebuke. Balaram [1] citing Homi Bhabha pinpoints about growing bureaucratic stronghold on scientific community and other slow process of file movement at glacial speed. It is true that the general absence of proper administrative set up for science is the biggest impediment to the growth of S&T than the paucity of fund or excellent manpower. Indian scientific community is commonly characterized by irrelevance and mediocrity which is due to lack of accountability and ethical and moral values [2]. In some scientific institutions scientific leadership themselves are party to the increasing bureaucracy and often these scientific bureaucrates/science managers/science lords are at par with bureaucrates. Pt. Nehru once remarked (*Indian Science Congress*) about the presence of scientific bureaucrates who could be as worst as bureaucrates themselves. As correctly pointed out by Nanjundiah [3] we rely more on personal connections than scientific standing for creating and chairing a post and as such are totally innocent of the way the science works. The board has a great opportunity to prove its worth by their right thinking, aptitude, behaviour, action and should be free from prejudices and nepotism and set up a model code of ethics and moral forms of science for building a national character.

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World-Class Universities

P. N. Srivastava
Former VC & Professor Emeritus JNU
163 National Media Centre, Gurgaon 122 002, India
Tel.: (0124) 2356188
e-mail: pns07@yahoo.com

We should be thankful to the Prime Minister and the Government for the policies they have adopted and the support they have given to social sectors, both education and health. For the first time in our history of over 60 years of our independence, we are thinking about universities and world-class universities besides, of course, primary and secondary education. Before thinking of creating world-class universities, we have to look what "university" means that we have forgotten. Its origin is from the Latin word *'universitas'* meaning the whole (world), that is university should be multidisciplinary and multi dimensional. And for this we will have to change the way we had been thinking and functioning.

Let us consider the top 15 universities in the world, whether by the standards of World Times Report or the Shanghai Report that did not consider universities with less than ten thousand students in their listing. These institutions were created as small good institutions centuries back that grew into world-class universities by their own efforts and what they did. They were not created as such. Even Nalanda had achieved its world-class status by their work and had not been created as such. What have we done to our best institutions in the country such as Calcutta, Bombay, Madras, and Allahabad etc. after we got our independence? We only saw them ruined doing nothing to save them. In fact, we were responsible to ruin them. We should only try to establish good institutions with good faculty and proper facilities whether we call them World Universities, National Universities or Central Universities and let then achieve world standards. The universities must start with good faculty, proper facilities, and be given total autonomy without any governmental control.

In India, even today, there are a few good universities that may not be world-Class but are still recognized internationally. Have we given them the recognition that they deserved? Some years back we decided to start Indian Institutes for Science Education and Research, on the recommendations of expert committees. They are deemed universities. Do they fulfill the meaning of a university, which should be multi-disciplinary, and multi dimensional? It is worthwhile to note what Prime Minister Manmohan Singh said in his Convocation address at Visva-Bharati University at Shantiniketan on 6 December 2008. He stressed upon

the need to expand the liberal education but opposed the current phenomenon of job-oriented education. “Our higher education puts emphasis on mainly preparing young men and women for the job market. And even in pursuit of this limited endeavour, sadly we see many shortcomings”

Why is it that the good universities of the country such as JNU, Delhi, Hyderabad, Pune or Jadavpur not considered to implement the idea of IISER? They could have done a better job with much less financial input. Another one is being created for Nanotechnology at Mohali, why has one of IITs, Indian Institute of Science, Bangalore or Jadavpur etc. not given this responsibility? There have been numerous small institutions established in Bangalore. Why is it that they were not made a part of Indian Institute of Science? Why was the National Brain Research Institute, a small institute, established in Manesar, near Gurgaon and not in All India Institute of Medical Sciences, where there would have been greater interaction among larger disciplines of brain research? Efforts, no doubt, had been made to establish the institute in JNU only for land and not for interactions with other related disciplines. An institute of Plant Genome Research has been created in JNU campus. Why was it not made a part of JNU or Delhi University where a team of good researchers in Plant Genome Research already existed and where interaction with a larger number of scientists would have been easier? I would not like to go into the reasons that were purely individual based and given political support. .

Let us look into the real world-class universities, Yale, Harvard, Princeton, California, Chicago, Oxford, Cambridge, and Tokyo etc. They are huge institutions that are multidisciplinary and multi-dimensional where interaction with various disciplines is possible rather than small institutions where it is not possible. In all these universities undergraduate studies form an important and integral part of studies. In India a good number of universities were established in the seventies including JNU and Hyderabad that had nothing to do with undergraduate studies. My own efforts to do this for Life Sciences failed since it was not allowed by the U.G.C. on the pretext that J.N.U was a postgraduate institution where undergraduate studies were allowed only in Foreign Languages since such programmes did not exist in other universities. In the University of Allahabad, where I was a student, the undergraduate course was the most important one. Post-graduate studies were meant more for guidance and training to stand on our own feet.

Let us consider the Deemed Universities. What was the philosophy behind starting ‘deemed universities’? It was that good colleges that were large multi-disciplinary and had established a reputation of being good institutions of long standing should be given selectively the status of deemed universities so that they could get freedom to initiate their own courses and syllabi. Some years

back the whole philosophy was discarded and hordes of new institutions and even a number of them without any reputation have been given this status more because of political considerations.

Before thinking of starting world- class universities, should we not think of helping some 20 to 25 best Indian universities to become world-class? We may give extensive financial support, change their acts and statutes asking them to impart under-graduate studies as well. I have devoted my life in universities for about 60 years starting from the University of Allahabad that was then one of the premier universities of the country, University of Rajasthan, Jaipur, that was made a very good university since the Vice-Chancellor, Mohan Sinha Mehta invited very good academics from all over the country and JNU where I was invited in 1974. What has become of the University of Rajasthan, Jaipur, because of political interference when people started leaving the university? I have written a lot about the attention being given to the universities. My Presidential Address given in The Indian Science Congress session at Jaipur, 1994 had even invited the attention of the editorials of the national dailies writing that my warning had come not a day too soon. Professor Sir John Kendrew, one of the Nobel Laureates that had attended the Congress had in his letter addressed to me said, “Your Congress was a great success and I particularly appreciated your own forthright remarks about the contemporary problems of Indian science. I only hope that they have met with some response from your government authorities.” Nothing of the kind happened. I had, of course, emphasized that whatever was true for science was, perhaps, worse for social sciences and humanities. I feel very happy that things are changing now and hope that we would make good use of the opportunity that has come our way.

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1. He/she should have allowed his name to appear as an author in only those publications in which he/she was actively involved, in data collection, theoretical formulation, design and construction of apparatus, field trips, mathematical derivation and calculations, statistical analysis and interpretation of results, as distinct from administrative support and providing funds or facilities.
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