

## **Keynote Address**

### **Some Adventures in Natural Product Chemistry and Higher Education**

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#### **A) HIGHER EDUCATION, SCIENCE & TECHNOLOGY**

After my appointment as Minister of Science & Technology in 2000 and later Federal Minister/Chairman Higher Education Commission in 2002, I persuaded the government to give a 6000% increase in the budget of science & technology and 2400% increase in the budget of higher education. This allowed us to launch major self-funded programmes to uplift our universities, develop high level S&T manpower and focus on the triple challenges of access, quality and relevance in higher education.

Pakistan has made remarkable progress during the period 2003-2008 in higher education which has directly impacted scientific research. The increase in scientific research output is nothing short of spectacular—600 per cent increase in scientific publications in international journals) and a similar increase in citations (the number of times the work of Pakistani scientists is cited by others in their references) in the same period, after decades of stagnation.

Pakistan has won four prestigious international awards in recognition of the rapid transformation in the higher education sector. Not a single Pakistani university could be ranked among the top 500 of the world during the 57-year period from 1947 to 2003. Today several of our universities are ranked among the top 300 and top 400 (National University of Science and Technology, NUST is ranked at 273, University of Engineering & Technology at 281 and Karachi University at 223 in natural sciences (Times Higher Education and QS rankings).

The major landmarks achieved have been:

- a) A new tenure track system was introduced that raised the salaries of Professors in universities to several times those of Federal Ministers in the government! The salary was raised to US \$ 5,000 per month (Rs325,000 per month) and the tax rate reduced from 35 per cent to only five per cent so that the salary levels rose to an amount equivalent to about US\$ 6,500 per month after considering the tax concessions. The appointments at this higher salary level were linked to positive international evaluations,
- b) About 5,000 Ph.D. level scholarships were awarded for study in technologically advanced countries (largest programme ever in the developing world) with about 10 million rupees being spent on each student. Some 3,000 indigenous Ph.D. scholarships were also awarded.
- c) The world's largest Fulbright Scholarship programme (US\$150 million) was launched with joint funding (HEC/USAID) to send 640 students to Ivy League universities in the US.

- d) A Digital Library was established in Pakistan which is regarded as one of the best digital libraries anywhere in the world: Every student in every public sector university today has access to 45,000 textbooks and research monographs from 220 international publishers as well as to 25,000 international research journals completely free of charge. The books are key word searchable and downloadable.
- e) Pakistan's first educational satellite (PakSat-1) was placed in space in 2001. The educational channels of the Virtual University and most of Pakistan's commercial channels operate on it. The distance learning programmes utilising it have resulted in increase in enrolment from only 89,000 in 2001 to 560,000 by 2008.

The Pakistan Educational Research Network (PERN) was established that provides high speed internet access to all universities. It is being upgraded to PERN-2 that provides 1GB connectivity to each university and 10GB connectivity to loops around major cities. This became possible because there was an explosive growth of internet in Pakistan during 2001-2002—internet spread from only 29 cities to over 1,000 cities and towns during this short period.

- f) University enrolment has tripled—it had reached to only 135,000 during the 56-year period from 1947 to 2003 but in the subsequent five-year period from 2004 to 2008, it increased to about 400,000.
- g) There were only 59 universities and degree awarding institutes in the year 2001 in Pakistan. These grew to 127 such institutions by 2008. Eighteen new campuses of existing universities were also established in remote localities to provide opportunities for higher education to deprived areas.
- h) The two year undergraduate degree was lengthened to four years so that the period of study from primary school to M.A/M.Sc. was increased to 18 years, in line with international norms, giving our degrees better prospects for international recognition.
- i) Plagiarism that had been rampant in universities was checked by the introduction of software that could detect cheating if the research publications or thesis had been copied from any other published source.
- j) The number of Ph. D. Produced during 2003 – 2008 was about the same as that produced in the previous 55 years (1947 - 2002).
- k) The promotion criteria for the faculty were toughened to ensure that only the best could be promoted to higher positions.
- l) Quality Assurance cells were set up in the university so that universities could have their own peer review of the processes, and regular external peer reviews were also initiated.

### **International Praise**

Pakistan's programme is now regarded as a model to be followed by developing countries. Indeed these phenomenal developments have been described as a 'Silent Revolution' by the World Bank in a comprehensive report. A number of editorials and articles have appeared in the world's leading science journal, *Nature* about this transformation. In its Editorial of 27<sup>th</sup> November 2007 entitled "The Paradox of Pakistan" (*Nature* 450, 585 (29 November 2007) | doi:10.1038/450585a) it commented about the two contrasting faces of the country—on the

one hand, it was a military dictatorship with its associated problems and on the other hand, it had implemented such a dynamic programme in the higher education sector.

An educational expert, Prof. Wolfgang Voelter of Tübingen University paid glowing tributes to the reforms undertaken by the Higher Education Commission in an article in Dawn on November 28, 2008 under the heading *The Golden Period*. He states: "***A miracle happened. The scenario of education, science and technology in Pakistan changed dramatically as never before in the history of Pakistan. The chairperson of the Senate Standing Committee on Education recently announced it as "Pakistan's golden period in higher education."***" Unquote. ([http://epaper.dawn.com/artMailDisp.aspx?article=23\\_11\\_2008\\_123\\_003&typ=0](http://epaper.dawn.com/artMailDisp.aspx?article=23_11_2008_123_003&typ=0))

Prof. Michael Rode, Former Chairman of the United Nations Commission on Science, Technology and Development and presently heading a Network of European and Asian Universities (ASIA-UNINET) wrote: "***The progress made was breath-taking and has put Pakistan ahead of comparable countries in numerous aspects.—The United Nations Commission on Science and Technology has closely monitored the development in Pakistan in the past years, coming to the unanimous conclusion that (the) policy and programme is a 'best-practice' example for developing countries aiming at building their human resources and establishing an innovative, technology-based economy.***" Unquote. (<http://dildipakistan.wordpress.com/tag/dr-atta-ur-rehman/>)

Pakistan has won a number of prestigious international awards for the revolutionary changes in the higher education sector brought about by the Higher Education Commission. These include the TWAS (Academy of Sciences for the Developing World, Italy) Award for Institutional Development at the 11th General Conference of TWAS in Durban, South Africa in October 2009 and the Austrian high civil award *Grosse Goldene Ehrenzeischen am Bande* (2007).

## **B) NATURAL PRODUCT CHEMISTRY**

Two third of the world's population relies on natural remedies for primary health care and the global annual sale of botanicals is over \$ 80 billion. These two statistics reflect the importance of natural products in health and economy. Access to reliable ethnomedicinal knowledge, combined with modern tools of research such as LC-MS/MS, LC-NMR, LC-MS/NMR, etc., and high-throughput screening protocols are greatly facilitating the process of drug discovery from natural sources.

We have investigated several hundred terrestrial and marine plants for their chemical and biological significance and isolated and identified over 2000 compounds of which some 600 turned out to be new and novel constituents with interesting biological activity profiles. In order to optimize the chances of finding novel leads, extensive primary biological screenings and activity-guided fractionation and purification were carried out. State-of-the-art spectroscopic techniques, especially modern multi-dimensional NMR techniques, were utilized to elucidate the structures of bioactive natural molecules, rapidly and accurately. The bioassay protocols include antibacterial, antifungal, cytotoxicity, phytotoxicity, insecticidal, antileishmanial, antioxidant and enzyme inhibition activities. The results so far have been truly exciting as we have identified several new classes of potent cholinesterase, urease, phosphodiesterase, glucuronidase, and prolyl endopeptidase inhibitors. A large number of antioxidant secondary metabolites have also been identified. In the majority of cases, chemical and microbial derivatizations were carried out to study the structure-activity relationships. A selection of these results illustrated by their potential application to treat diseases such as epilepsy will be presented. Synthetic approaches to bioactive anti-cancer compounds have also been developed.

**PROF. ATTA-UR-RAHMAN, FRS**

Prof. Atta-ur-Rahman obtained his Ph.D. in organic chemistry from Cambridge University (1968). He has 843 publications in several fields of organic chemistry including 663 research publications, 18 patents, 103 books and 59 chapters in books published largely by major U.S. and European presses. Seventy five students have completed their Ph.D. degrees under his supervision.

Prof. Rahman is the first scientist from the Muslim world to have won the prestigious UNESCO Science Prize (1999) in the 35 year old history of the Prize. He was elected as Fellow of Royal Society (London) in July 2006 thereby becoming the one of the 4 scientists from the Muslim world to have ever won this honour conferred by the prestigious 360 year-old scientific Society. He has been conferred honorary doctorate degrees by many universities including the degree of Doctor of Science (Sc.D.) by the Cambridge University (UK) (1987), Honorary degree of Doctor of Education by Coventry University UK in November 2007, Honorary D.Sc. degree by Bradford University (2010) and Honorary Ph.D. by Asian Institute of Technology (2010). He was elected Honorary Life Fellow of Kings College, Cambridge University, UK in 2007. Prof. Atta-ur-Rahman was conferred the TWAS Prize for Institution Building in Durban, South Africa in October 2009 in recognition of his contributions for bringing about revolutionary changes in the higher education sector in Pakistan. The Austrian government also honoured him with its highest civil award ("Grosse Goldene Ehrenzeischen am Bande") (2007) in recognition of his eminent contributions.

He is President of Network of Academies of Sciences of Islamic Countries (NASIC) and the Vice-President (Central & South Asia) of the Academy of Sciences for the Developing World (TWAS) Council, and Foreign Fellow of Korean Academy of Sciences. Prof. Atta-ur-Rahman was the President of the Pakistan Academy of Sciences (2003-2006) and was again elected as the President of the Academy from 1<sup>st</sup> January 2011.

Prof. Atta-ur-Rahman was the Federal Minister for Science and Technology (14th March, 2000 – 20th November, 2002), Federal Minister of Education (2002) and Chairman of the Higher Education Commission with the status of a Federal Minister from 2002-2008.

Successive Governments of Pakistan have conferred four civil awards, including Tamgha-i-Imtiaz (1983, President General Ziaul Haq), Sitara-i-Imtiaz (1991, Prime Minister Mohtarma Benazeer Bhutto), Hilal-i-Imtiaz (1998, Prime Minister Nawaz Sharif), and the highest national civil award Nishan-i-Imtiaz (2002, President General Musharraf), on him.

Prof. Atta-ur-Rahman is presently the Coordinator General of COMSTECH, an OIC Ministerial Committee comprising the 57 Ministers of Science & Technology from 57 OIC member countries. He is also the Patron of International Centre of Chemical and Biological Sciences (which comprises a number of institutes, including the Husein Ebrahim Jamal Research Institute of Chemistry and the Dr. Panjwani Center of Molecular Medicine and Drug Development) at Karachi University.