



## DR. I.H. USMANI AND THE EARLY DAYS OF THE PAEC

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Combining a scientific background with the power of a senior civil servant, Dr. I.H. Usmani laid a sound foundation of the atomic energy programme in Pakistan. First he developed top quality manpower. He recruited the best graduates of Pakistani universities, arranged their training at world famous universities and nuclear establishments. Next, he established the case for nuclear power. Feasibility studies concluded that electric power needs 40 years hence could not be met by conventional sources. Only nuclear power could fill the gap. International competition led to the Karachi Nuclear Power Project, which began producing electric power in 1972. Meanwhile Atomic Energy Centres at Lahore and Dacca and PAEC's premier research establishment, PINSTECH, conducted manpower development and R&D on radiation applications. An architectural masterpiece, PINSTECH earned a reputation for its high quality research. Dr. Usmani motivated the PAEC officers as well as staff to produce their very best. In return, he rewarded them with generous service conditions. He demonstrated that the gap between science and technology could be bridged by versatile scientists who could quickly acquire new skills with the help of modern information facilities. Successful administrative reforms in PAEC were emulated by universities and science establishments in the country.

**Keywords :** Atomic energy, Research and development, PAEC, Pakistan, Nuclear science, Dr. Usmani

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### 1. Background

Dr. Ishrat Hussain Usmani (15 April 1917 - 17 June 1992) is generally regarded as an outstanding Chairman of the Pakistan Atomic Energy Commission (PAEC). He joined the fledgling organization as Member in 1959; nurtured it to maturity as Chairman from 1960 to 1972; and then left under dramatic circumstances. This article summarises Dr. Usmani's achievements in the PAEC and attempts to capture the personality of this extraordinary individual that made working with him so exciting.

Dr. Usmani happened to possess just the right background to lead the Pakistan Atomic Energy Commission. Born into a respected, cultured family of Delhi and Aligarh, where education received top priority, he graduated in 1936 from the Muslim University Aligarh with a B.Sc (Hons) degree, followed with an M.Sc in Physics from the University of Bombay.

In 1937 the young Ishrat Usmani proceeded to the Imperial College, University of London, for research in atomic physics with the Nobel Laureate Professor P.M.S. Blackett. He produced a thesis entitled "A study of the growth of compound

crystals by electron diffraction" in 1939, thus completing his PhD in less than 2 years.

That allowed him sufficient time to prepare for and pass the coveted Indian Civil Service (ICS) examination in 1942.

Joining the ICS meant virtual 'coronation' in those days, as it suddenly elevated one to the highest level in the ruling establishment in India – a status far greater than that enjoyed by present-day CSPs or IASs. Grooming in leadership, and given positions of great responsibility, soon converted a bright boy into a powerful arm of the inner circle in the Government. An ICS officer possessed high confidence, learning, sportsmanship and diligence. His word was Law!

Opting for Pakistan in 1947, Dr. Usmani served in various top Government posts, including Chief Controller of Imports and Exports, before catching the eye of Zulfikar Ali Bhutto, then a young minister in President Ayub Khan's cabinet, as the ideal person to lead the PAEC. Bhutto got Dr. Usmani appointed as full-time Member in the PAEC in 1959, and after a brief period in training, as Chairman in 1960. Recognition of Dr. Usmani was also a token of the importance attached to atomic

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energy by the Government.

Dr. Usmani lost no time in making his presence felt not just in the PAEC but all over the country. He began implementing an ambitious three-pronged plan for the Commission that had been in the making under his predecessor, Dr. Nazir Ahmad. His innovative methods also influenced sister departments such as the universities and concerned government departments to support science and technology through better planning and funding.

## 2. Manpower Development

As soon as Dr. I.H. Usmani took over the PAEC he realized that atomic energy provided a powerful tool for development and modernization, but nothing could be done without a sufficient number of qualified, intelligent group leaders and supporting scientists. He, therefore, embarked on an ambitious programme of manpower recruitment and training.

### 2.1. Ambitious recruitment

Dr. Usmani set up a pattern of recruitment each year of about 50 of the best and most promising of M.Sc's in physics, chemistry, geology, etc., and B.Sc's in engineering from all the Pakistani universities without any favour or discrimination. These Officers on Special Training (OSTs), as they were called, were given a Nuclear Orientation course at the Atomic Energy Centre in Lahore, before being sent to universities and research establishments abroad, to obtain PhDs in nuclear sciences or get post-doctoral research opportunities. The most relevant training took place at the UK Atomic Energy Establishments at Harwell and Winfrith, in Chalk River Nuclear Laboratory in Canada, and at the Universities of Birmingham, Manchester, Sydney, Toronto, Stanford and Rochester.

He combed the best institutions around the world for academic programmes in nuclear sciences and engineering for new M.Sc's or B.Sc's in engineering. North Carolina State College of the University of North Carolina was the first in the world in 1953 to establish nuclear engineering programmes, followed closely by the University of Michigan, Pennsylvania State University, and Massachusetts Institute of Technology. These new programmes welcomed trainees from abroad and were encouraged by the US Government, by providing financial stipends as an element of the Atoms-for-Peace movement. The PAEC also

utilized well-established Ph.D programmes in nuclear physics, nuclear chemistry, materials science, geology, agriculture, nuclear medicine and other nuclear sciences, offered by Universities in Canada, UK, Australia, France and other countries.

### 2.2. Nuclear engineering training

Not so easy to find were appropriate facilities for advanced or on-the-job training in nuclear reactor science and technology for relatively older engineers and scientists. National laboratories in the United States, established for R&D in nuclear weapons development from 1945, were slowly beginning to open up or "declassify" portions of their facilities for atoms-for-peace Plowshare programmes promoting nuclear power plants for electricity production. Physical separation of classified and open facilities remained a problem. Consequently, such training was not readily available.

Persistent efforts by Dr. Usmani, highlighted by several well-planned world tours by him, did establish personal contacts that opened up a number of valuable opportunities. These included placements at two of the principal "atomic energy laboratories" in the USA, viz. Oak Ridge National Laboratory (ORNL) in Tennessee and Argonne National Laboratory near Chicago. Funding for the PAEC "trainees" generally came from the US International Cooperation Administration, which later became the United States Agency for International Development (US AID).

Argonne National Laboratory near Chicago was the first to establish an International School of Nuclear Science and Engineering (ISNSE) in 1954 to provide a one-year training course in reactor engineering. The first semester of ISNSE was conducted at NC State University and Penn State University. In the third ISNSE batch in 1956 there went PAEC trainees Munir Ahmed Khan (later Chairman) and Mohammad Yusuf (later Member).

Oak Ridge National Laboratory conducted a somewhat higher level course at its Oak Ridge School of Reactor Technology (ORSORT). It offered two options for specialization: reactor operations or reactor hazards evaluation. The PAEC sent 10 engineers to ORSORT, mostly in the operations option. Of the ten, only Saeed Zahid chose the hazards evaluation option, but he did not remain long in the PAEC. That is one reason why

safety analysis remained rather weak in the PAEC in those days.

ORNL also illustrates the difficulty of separation between classified and open work. Dr. Usmani's international contacts had promoted personal relations with key ORNL leaders such as Dr. Alvin Weinberg and Dr. Robert Charpie. He asked them to arrange an on-the-job training programme in nuclear science and engineering for a team of PAEC personnel. What he really wanted was to create the nucleus of a specialist research, development and design group in nuclear power engineering. Unfortunately, the main reactor engineering effort at Oak Ridge at that time was located in the classified Y-12 area. Several miles away stood the relatively open X-10 site, where there was little reactor engineering. The team Dr. Usmani had in mind stood at a higher level than ORSORT. ORNL could therefore only offer attachment of individual scientists and engineers, including this author, to working groups in different Divisions at X-10. The PAEC decided to accept what it could get for training opportunities at ORNL, even though a nuclear engineering team could not be brought together at Oak Ridge.

This author happened to be the only case in the PAEC at that juncture of a scientist already having a Ph.D in nuclear engineering before joining the Commission, as well as relevant post-doctoral experience.

### 3. Three Pronged Attack

As these OST's began returning to Pakistan fully trained and confident, they assumed group leaderships in the rapidly evolving projects of the Commission. Once assured of the nucleus of adequately trained manpower, Dr. Usmani unfolded his plan of work.

Dr. Usmani often described his plans for atomic energy in Pakistan as a three-pronged attack:

1. Nuclear power plants to alleviate the shortage of conventional energy sources;
2. Research and development on problems of national importance;
3. Applications of radioisotopes and nuclear radiations in agriculture, medicine and industry.

#### 3.1. Nuclear power

As soon as Dr. Usmani took over chairmanship of the PAEC he began a series of studies on the feasibility of introducing nuclear power in Pakistan.

He commissioned the American firms of Gibbs and Hill and Internuclear Company to conduct a joint study. Their May 1961 report entitled "Study of the Economic Feasibility of Nuclear Power in Pakistan", known as the Gibbs & Hill report, became the standard reference on nuclear power for the PAEC.

Outside the PAEC but linked to it through Dr. Usmani's chairmanship of both organizations, the Power Commission of the Government of Pakistan had independently conducted surveys of projected power needs in the country in the next forty years and how these could be met through nuclear power plants.

These studies concluded that conventional sources of energy (natural gas, coal or hydroelectric) could not supply even the minimum projected demand. The case for nuclear power was clear.

Finally, the International Atomic Energy Agency carried out an authoritative analysis of the current energy picture in the country. The 1962 IAEA report "Prospects of Nuclear Power in Pakistan" concluded that the growing electricity requirements of Karachi could well be met by nuclear power instead of natural gas, while gas should be conserved as a non-renewable petrochemical whose value lay in its chemical content, not for burning in a heat engine that wasted over 60% of the heat content into the condenser.

#### 3.2. International marketing

By 1963 Dr. Usmani had developed his standard presentation on the feasibility of nuclear power in Pakistan. He would begin by showing that the per capita consumption of energy in a country was directly related to its prosperity or Gross Domestic Product. Taking a 40-year span to the end of the century he would project the power needs of Pakistan for high and low growth rates. He would survey all the resources available to meet those needs and show that there remained a clear gap between supply and demand that could only be filled with nuclear power. Dr. Usmani's fervour in these presentations gave credence to the economic inevitability of nuclear power to be developed as an alternative energy source. It would be clean, pollution-free and perfectly safe. The beneficial spin-off in pulling up the national industrial infrastructure and scientific base could be revolutionary.

This presentation came up in numerous PAEC brochures that Dr. Usmani presented to visitors or to audiences at his frequent seminars. He loved exposure, giving public talks about once a week on the average. His repertoire included a whole range of original ideas covering the management of science and engineering, industrial development, the causes of poverty of Islamic nations, and how nuclear power offered a panacea to many of our problems in Pakistan.

Armed with all these feasibility studies, Dr. Usmani embarked on an extensive programme of courting nuclear power plant suppliers in different countries, both in the private sector as well as public corporations. His suave style and confidence enabled him to get strong support from successive governments of Pakistan and Pakistani embassies abroad.

It was Dr. Usmani's vision, persistence and energy that ultimately led to the construction and successful operation, in 1972, of Karachi Nuclear Power Plant, first in the Islamic world.

### 3.3. *R&D and manpower development*

The second enduring remembrance of Dr. Usmani, and Prong 2 of his triad, remains his stewardship of PAEC's premier research establishment called the Pakistan Institute of Nuclear Science and Technology (PINSTECH).

Building a world-class research establishment also gave him the opportunity to exercise his abundant artistic talent. He took particular interest in creating a laboratory that was a masterpiece of architecture, first by choosing the world-famous Edward Durrell Stone as architect, and then by paying full attention to every detail in construction and furnishing of the facility.

Dr. I.H. Usmani conceived the Pakistan Institute of Nuclear Science and Technology as an architecturally inspiring edifice that would motivate scientists. He succeeded admirably in giving to the nation a building to be proud of, a beauty in the tradition of Agra's Taj Mahal.

His partner in the creation remarked in the PINSTECH Visitors Book:

"This case (PINSTECH) has been my greatest work. I am proud that it looks like it belongs in this country with such a rich architectural heritage. I am grateful for the inspired guidance of Dr. Usmani".

Edward D. Stone, Architect of PINSTECH; April 20, 1965

The Pakistan Institute of Nuclear Science and Technology is easily the most beautiful nuclear laboratory in the world. It soon also established a high standard in nuclear research and development, of a quality matching the fine architecture.

Dr. Usmani considered an important by-product of R&D to be the production of trained manpower within the country. Two strategic goals for PINSTECH thus became:

1. Research, development and teaching in nuclear science and engineering; and
2. Production of highly skill full manpower of scientists and supporting staff who could be moved on to any projects of national importance.

### 3.4. *Bridging the gap*

PINSTECH carried both of the words *science* and *technology* in its very name, for the first time in Pakistan for a major establishment. The title suggested an intent to bridge the gap between pure and applied science. A conscious effort to make oneself useful resulted soon in several R&D studies for the Karachi Nuclear Power Plant (KANUPP), applications of radioisotopes and radiations, and contributions to other early projects of the PAEC. PINSTECH was later called upon to serve a national project, and it heeded the call.

Reducing the gap between pure science and technology or applied science required excellence. The same innovative thinking acquired by a quality scientist makes him versatile enough to tackle an engineering problem, given the fast learning possible with today's facilities such as the Internet. It took Dr. Usmani's genius to grasp the fact that *excellent science breeds versatility*. The reverse is also true: *versatility is a pre-requisite for excellence in science*.

By tackling new problems systematically, retrieving technical information effectively, and managing his team professionally, a good scientist could acquire the required skills quickly, and undertake technology development successfully. This was proved at PINSTECH, thanks to Dr. Usmani's nursing of quality culture.

We first came across the PINSTECH concept in the summer of 1961 when a group of PAEC fellows

at Oak Ridge were called to the New York office of the above-mentioned famous architect Edward Durrell Stone to examine his preliminary plans for the Institute. Stone had developed an architectural concept around a quadrangular structure laid out in the manner of a Mughal garden. All of us were rather awed and overwhelmed by the grand artistic theme, contrasting completely with the simple functional design proposed earlier by AMF Atomics, the reactor suppliers.

Most of us felt that the Stone design was too inflexible for a scientific laboratory which should be readily alterable for changing research projects. Dr. Usmani however told us not to worry about the architecture but just think of the possible work to be done in the laboratories. We were to ensure that sufficient laboratory space and basic facilities were provided. Labs requiring more space could be established in the PINSTECH basements or entirely outside the main quadrangle. That indeed turned out to be the case.

Dr. Usmani's enthusiasm for innovative architecture was matched by the care he took in selecting group leaders and outfitting the labs for maximum utility. Soon PINSTECH earned a name for itself as a first-class research complex engaged in work of national importance.

### 3.5. *Radioisotope applications*

The third tier of Dr. Usmani's triad was more publicly visible. Radioisotopes in tiny quantities could be used as tracers to study the movement of fluids in humans, animals, plants and industry. Massive nuclear radiation sources emitting gamma radiation could be employed for the treatment of cancer, development of new varieties of crops, and a myriad of other applications. Centres were, therefore, established all over the country for atomic energy applications in agriculture, medicine and industry.

Three research centres for agricultural applications were set up as the Atomic Energy Agriculture Research Centre at Tando Jam in Sindh, the Nuclear Institute of Agriculture and Biology (NIAB) in Faisalabad, and the Nuclear Institute for Food and Agriculture (NIFA) at Tarnab near Peshawar.

Atomic energy medical centres were established in conjunction with large public hospitals, beginning with Karachi and Lahore, and later took on publicly recognizable names such as

INMOL (Institute of Nuclear Medicine & Oncology at Lahore), NORI (Nuclear Oncological & Radiotherapy Institute) at Islamabad, IRNUM (Institute for Radiotherapy & Nuclear Medicine) at Peshawar, and similar establishments at Multan, Jamshoro, Quetta and Larkana. The expansion continues today into Bahawalpur, Faisalabad, Abbotabad and Gilgit. Many hundreds of thousands of people have been treated at PAEC's nuclear medical centres.

In industry, the nuclear applications have followed public needs, such as for sterilization of medical sutures and supplies at a plant near Lahore, run by Al-Technique, a subsidiary of the PAEC. The Atomic Energy Centre Lahore provided gamma radiography support and training to private sector companies, developed level gauges for bottling, thickness gauges in paper manufacture or other filling, solar energy applications such as a Silicon Powered Lamp (SIPOLA). Strict quality assurance techniques required in the nuclear power industry were promoted in initiatives, like a Welding Institute and a Directorate of Quality, that continue to serve industrial needs with merit. A Directorate of Industrial Liaison promoted direct growth of capabilities in local industries required for the nuclear power programme.

All these activities were controlled from the PAEC Headquarters in Karachi, where Dr. Usmani kept strict watch.

## 4. **Dominating Presence**

The most remarkable feature of the PAEC from that period, i.e. the 1960's, was the dominating presence of Dr. I.H. Usmani. He would call senior scientists to his office, give rapid-fire orders, lash out at under-performers in everyone's presence, and indulge in long discourses on any topic under the sun. It was always a pleasure to listen to him, often well beyond the office hours and late into the night. Dr. Usmani had a whole repertoire of engaging small talk. He would grow passionate in describing his vision for the country, how science and technology could do wonders, and the unlimited potential of nuclear energy.

His serious discussions would be interspersed with light jokes, keeping all spellbound.

His animated pep talks infused vitality in those near him. In the words of A.M. Faruqui<sup>1</sup>: "His

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<sup>1</sup> A.M. Faruqui, "A Pakistani who made dreams come true", *Pakistan Link* Editorial, 21 November 2003

eloquent King's English seemed to fill the spacious room and beyond to hold the entranced gathering in a state of ecstasy and awe."

#### 4.1. *Motivating*

Dr. Usmani kept the PAEC officers as well as staff on their toes, determined to produce their very best. In return, he rewarded them with generous service conditions.

He motivated the pick by insisting on high standards<sup>2</sup>, snubbing average performers with embarrassing public dressing-downs, ignoring even satisfactory performers who could do better. He delighted in those with a spark, stroking them with perks, such as frequent visits abroad. His long conversational pep-talks often looked like *darbars*.

He could get away with major innovations to streamline administration through greater delegation of power to officers, generous starting salaries and allowances, and freedom in work planning. He offered as many as five advance increments in the Senior Class 1 scale to PhDs with nuclear orientation.

He could afford to install new rules, anathema to conservative *babus*, because of his personal influence through the ICS /CSP network, and direct contacts with decision makers all the way up to the President and Ministers. His bypassing of bureaucracy did not endear him to those bypassed or over-ruled. Many lesser souls waited in the wings to extract revenge, having never relished Usmani's admonitions to bring Pakistan into modernity with establishment reform. Some resented the special high status enjoyed by the PAEC. Even in the PAEC there were a very few who disliked the long hours, stress & strain, and time wasted in lineups of senior officers at airports to receive the Boss or see him off.

#### 4.2. *Publications*

The breadth of Dr. Usmani's interests could be seen in the series of writings that he produced on a wide range of topics. In particular, a special issue on Atomic Energy of the monthly magazine Trade and Industry in April 1964 contained a long article by Dr. Usmani on the case for nuclear power in Pakistan, plus much other supporting material.

This article, and Dr. Usmani's standard speech at public forums, drew a 40 year projection for East

and West Pakistan's electricity demand and supply, and proved convincingly that the shortfall could not be met by conventional sources of energy, even if all the sources were exploited.

Publication of NUCLEUS, the quarterly journal of PAEC, started at the-then Lahore Centre in 1964. The Founder and first Editor was Dr. Saeed A. Durrani, then the Director of the Atomic Energy Centre, Lahore.

Pak Atom, the monthly newsletter of PAEC began in 1968. In due course PAEC introduced illustrated brochures for each establishment. A notable publication was a list of PAEC Scientists and Engineers. It came out in three editions, the last in 1970. After that it became too sensitive to publish as it would reveal the strength of the PAEC.

The topics of his papers ranged from national energy policy, science and technology development, electronics policy, industrial growth, and covered almost all areas of national development.

### 5. **Science & Technology**

Dr. Usmani succeeded in elevating the role of science and technology, including atomic energy, in the country. He brought respect to scientists. He prevailed on the government to give higher salaries to scientists, more than double the existing rates. He wanted his scientists to be better off than CSPs, the Civil Service of Pakistan then being the most glamorous of professions in Pakistan. A liberal policy on high emoluments, frequent extended visits abroad and other attractive perks contributed to bestowing the desired aura to PAEC employment. The policy paid off as the collected talents soon began producing results of national and international importance in science and engineering.

#### 5.1. *Professor Salam*

Usmani's most trusted friend and advisor on science policy in those days (the 1960's) was Pakistan's eminent scientist and the would-be Nobel Laureate Dr. Abdus Salam, Professor of Theoretical Physics at Imperial College of Science and Technology, University of London, and Director of the International Centre for Theoretical Physics, Trieste, Italy. Salam and Usmani worked as a powerful team to obtain national and international support for the development of science and technology as fundamental to

<sup>2</sup> N.M. Butt, "Remembering an Unsung Hero", *The Nation*, 22 August 1999

economic growth. The only difference between the two stemmed from their different backgrounds. Usmani would add a T for Technology to Salam's pursuit of Research & Development (R&D) to make it RD&T.

### 5.2. *National perspective*

The benefits trickled to outside the PAEC. First, Dr. Usmani offered an umbrella within the PAEC to all talent by hiring people in all kinds of disciplines. Many scientists from other research organizations and universities in the country left their organizations to join the PAEC. Even some arts people joined; they were given assignments such as writing the history of Muslim science. With the support of Professor Salam, who remained a Member of PAEC for many years, PAEC served as the germination pod for the future Quaid-i-Azam University Physics Department. When the other scientific organizations and universities saw the PAEC taking away their best people they were soon forced to liberalize their own salaries and rules. In particular, Pakistan Council of Scientific and Industrial Research (PCSIR) adopted salary scales similar to the PAEC's. The benefits soon extended to the entire nation. These gains to science and engineering were lasting.

In this way the Commission has gone beyond its basic task of introducing nuclear power. It seeks to encourage general excellence among Pakistani scientists and engineers.

At his initiation a separate Ministry called the 'Ministry of Science and Technology' was created by the Government of Pakistan in 1972. Establishment of the Pakistan Science Foundation was also one of his achievements. Thus an Aid to Universities' programme began to disburse funds for needy scientific projects.

## 6. **National Defence Programme**

Zulfiqar Ali Bhutto came to power as President in December 1971, following the loss of East Pakistan. Within a month he called a meeting of all senior scientists and engineers of the PAEC to set goals for the Commission.

This meeting took place at Multan on 20-21 January, 1972. Bhutto lost no time in announcing publicly that Usmani was being replaced by Munir Ahmed Khan, who happened to be a welcoming host in Vienna during Bhutto's travels in Europe, following his ouster from Ayub Khan's cabinet in 1966. Munir Khan had the right background as an

alumnus of Argonne National Laboratory and its International School of Nuclear Science and Engineering, followed with many years as an employee of the International Atomic Energy Agency (IAEA) in professional grade P5.

Dr. I.H. Usmani had carefully and painstakingly built up Pakistan's nuclear power infrastructure over the previous decade. Privately he tried very hard to divert Bhutto from embarking on a nuclear weapons programme. Following the fateful Multan conference, Dr. Usmani's voice was safely silenced.

## 7. **The End**

The year 1971 was tragic for many. The country fought a war with India and lost East Pakistan. Dr. Usmani faced growing discontent among PAEC employees due largely to political uncertainty. This author survived a serious automobile accident in October of that year that rendered him physically too weak to handle the job of Director, PINSTECH.

Munir Ahmed Khan got a full month, between Zulfiqar Ali Bhutto's personal call to him on 20 December 1971 and the public announcement at Multan on 21 January 1972, to prepare for his new job. He took the time to visit most of the PAEC establishments, beginning with PINSTECH, to find out for himself what was bothering the scientists. Statements made to him by any disgruntled officers served like an audit, enabling him to find the best solution to each malaise. It soon became obvious that he was coming as Chairman. The detailed inspection of PAEC provided Munir Khan with a first-hand awareness of the major problems facing the Commission and the actions needed to solve them.

After Dr. Usmani's transfer to the Ministry of Science and Technology in January 1972, he learned to remain quiet in the circumstances, did much reading and marked time.

In November 1972 PAEC celebrated the attainment of full power at KANUPP with several events, including an international seminar and a formal visit of the President to KANUPP. KANUPP was hailed as the first nuclear power plant in the Muslim world. The only regret was that its creator Dr. Usmani for some reason could not attend.

Since 1974 Dr. Usmani resigned from service in Pakistan, and his allegiance transferred to the United Nations when he took up an appointment

with the UN Environmental Program in Nairobi, Kenya.

Dr. Usmani served as Senior Energy Adviser to the United Nations in New York, remaining there until 1985.

His last post took him to London, England, where he took the lead in establishing a new organization, called New and Emerging Sciences and Technology (NEST). He served as the Secretary General of NEST with the financial support of the banker Agha Hasan Abdi. He spent his later years commuting between Karachi and London, where he was often consulted by the Third World Foundation and other development agencies.

Dr. Usmani finally retired in 1991 and passed away in Karachi on June 17, 1992. The occasion brought tears to the eyes of many scientists<sup>3</sup> and reformers who regarded him with affection.

The nation belatedly recognized his vital services by awarding him the Nishan-i-Imtiaz posthumously some years later.

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<sup>3</sup> N.M. Butt, personal communication