
Daulat Singh Kothari (1906–1993)*

Scientist, Teacher, Administrator and Humanist

India has been fortunate to have had a band of dedicated and inspiring leaders at the forefront of all spheres of human activity at the time of independence. They provided the basic foundations for nation-building. In the field of education, one such luminous example was Professor Daulat Singh Kothari. He played many roles—scientist, teacher, educationist, planner, and administrator—all successfully and always with a human touch.

Daulat Singh Kothari was born on 6th July 1906 at Udaipur to Fateh Lal Kothari and Lahar Bai (nee' Ordia) as the eldest of four sons and a daughter in a devout Jain family. He started his schooling at Udaipur, where his father was headmaster but after the early death of his father in 1918, he stayed with his father's friend, who was the Chief Minister of Indore and completed his schooling. He was awarded a scholarship by Maharana of Mewar for topping the intermediate science examination in 1924 at Udaipur. It allowed him to attend Allahabad University where he was taught by M N Saha. He completed his BSc degree in 1926 and MSc in 1928 at the top of his class. Saha was impressed by Kothari's intellect and interest in physics and offered him the position of demonstrator in physics at Allahabad University [1]. His research work started even before he completed his master's degree and his first paper was with G P Deodhar on the elastic properties of India rubber. His first single-author paper was published in 1929, wherein he studied in detail Doppler-Fizeau effect considering light in the form of light quanta. He went to Cavendish Laboratory on a U.P. Government fellowship in 1930 and worked with Ernest Rutherford, P Kapitza, and R H Fowler. While at Cavendish, he made many notable contributions to quantum statistics, properties of degenerate matter, the internal constitution of stars, and other related topics. In 1933, he got his PhD degree from Cambridge University and returned to India to rejoin his post at Allahabad University.

Kothari joined the University of Delhi in 1934, on Saha's advice, as a Reader and Head of the Department of Physics. He had to start from scratch in creating the infrastructure for teaching and research. Postgraduate courses were started at the university in 1942, and Kothari was then appointed as Professor of Physics. He set about gathering a good team of physicists, and the department soon became a leading centre of learning not only in India but also at the international level. Under his stewardship, every faculty member was required to participate in the laboratory supervision of students, be he a theoretician or an experimentalist. Prof.

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Kothari always encouraged the younger members to express their opinion freely. In contrast to many other universities and institutes in India at that time, an enormous degree of freedom and autonomy characterised the functioning of the physics department at Delhi University.

He continued his research activities at Delhi with great vigour along with his teaching assignments. In both the activities, he was ably assisted by R C Majumdar, who was his colleague from Allahabad days and later joined the Delhi University. They computed the opacity coefficients of electron degenerate matter using a rigorous quantum mechanical treatment and showed that energy flow in degenerate stellar cores is mainly due to thermal conduction and not by radiative process. In 1936, after it was established that the neutron mass exceeds the mass of the proton by a small amount, Kothari, incorporated this idea in his paper, 'Neutrons, Degeneracy and White Dwarfs' [2]. He established the existence of an upper limit for the pressure exerted by degenerate electron gas and showed that hydrogen-containing white dwarf stars must have a radius less than about 6.4×10^6 m. Although he did not state it explicitly, this paper clearly hinted at the presence of neutrons in the cores of white dwarf like stars beyond a certain mass. His work on the theory of pressure ionization was a tour de force contribution to the behaviour of matter under high pressures and was applicable to white dwarf stars to planets. This paper is reproduced from the *Proceedings of the Royal Society (London)* in the classics section of this issue of *Resonance* [3].

Kothari and his colleagues at Delhi University, F C Auluck and R C Majumdar, introduced other interesting ideas in statistical mechanics. They were among the first to use in this context Ramanujan's famous theory of partitions to high polymers. They studied Fermi-Dirac and Bose-Einstein gases in a uniform field of force, thermodynamics of relativistic Fermi-Dirac gas, etc. Kothari studied the nature of the spectrum of non-equilibrium radiation and called it non-degenerate radiation and showed that departures from black-body radiation observed in stellar studies could be accounted for by his theory. Later, with M N Saha, he also studied the magnetic monopole which had been proposed by Dirac. Kothari's interest spanned many branches of physics and the topics he investigated over more than three decades were hole theory of the liquid state, bounded harmonic oscillator, kinetic theory of rubber, liquid drop model of nuclei, Fermi's theory of particle production, Riesz potential, colour centres in solids, armour penetration in ballistics, radiation and sensation of pain, etc. He guided a number of teachers and research scholars in fields like plasma physics, magneto-hydrodynamics, quantum electrodynamics, relativistic quantum statistics, and encouraged them to publish their results independently.

In 1948, Kothari was offered the post of Defence Scientific Advisor to the Government of India. He accepted it but continued to draw the same salary as that of a university professor and not the higher one he was entitled to as the advisor. But as he had to exercise the financial powers



of advisor, he agreed to draw a token salary of Rs. 1 from the ministry. He also continued teaching some classes at the university in parallel. During his term as the Defence Scientific Advisor, he was on leave from the university for the period 1949 to 1951. He returned to the university in 1951 but continued as Honorary Scientific Advisor to the Ministry of Defence till 1961 when he became the Chairman of the University Grants Commission (UGC). Even as the Chairman, UGC, he continued taking classes at the MSc level once a week. On his retirement from Delhi University in 1971, he was appointed Emeritus Professor and remained in touch with the department throughout his life.

Kothari was an inspiring and highly gifted teacher who believed in explaining the concepts first before going into the mathematics behind them. He would also point out the areas where ambiguities of knowledge exist and possibilities of further research. He firmly believed in the necessity for a teacher to be always a student and keep learning. On the very first day of his class, he would tell the students that he was a senior student himself while his audience were junior students, and they would learn together. In his address at Jamia Milia Islamia on the golden jubilee celebration of the Faculty of Education, he clarified the role of a teacher.

“The “message” of the teacher to the students is not merely to impart knowledge content of books which is largely information fast getting out of date. But more than that it should be inspiration, by his/her example, towards the process of character building and the use of knowledge for welfare of the community. The total message to the students, and to the community, is the total life of the teacher.”

The importance given by him to teaching is illustrated by an oft retold incident. Once when he was interrupted during a class with the message that the “Defence Minister wishes to speak to him on phone”, he told the messenger politely to inform the caller that “he (Professor Kothari) was busy in a class and would call the Minister after the class was over” [4].

He was associated with the National Council of Educational Research and Training (NCERT) from its inception and guided its work. His interest in the nurture and growth of young people led to the National Science Talent Search Programme started by the NCERT. He was also instrumental in starting the Young Scientist Awards of the Indian National Science Academy.

As Advisor to the Defence Minister, he planned and nurtured the growth of defence science in the country which has grown into the Defence Research and Development Organisation (DRDO) overseeing more than 50 laboratories. In the words of his co-workers Venkatesan and Nagaratnam [5], “In giving a direction and a coherent shape to the Defence Science Organization, Professor Kothari had no precedents to go by. It is a tribute to his clear thinking and visionary foresight that he unerringly identified thrust areas of relevance in the country’s geopolitical (both the then existing and anticipated future) context”. He also got the right per-



sons selected for leading these areas of work and each area of work thrived to grow into vibrant research institutions. Even in the Defence Science Organisation, he not only played the role of planner and administrator but also mentored the scientists and himself contributed to designs of equipment and armour. One of the laboratories, the Institute of Nuclear Medicine and Allied Sciences (INMAS) that he helped plan, was probably the first independent institute of its type in the world devoted to nuclear medicine. Kothari can rightly be called the architect of defence science in India.

Kothari's appointment as the Chairman of the University Grants Commission in 1961 brought him in contact with the wider educational system of the country. During his tenure, several schemes to improve the quality of research in the universities were introduced, e.g., designating a few high performing departments as Centres of Advanced Study for a fixed period at a time, scheme to utilise services of outstanding faculty beyond their superannuation for a few more years.

It also led to his appointment as Chairman of the Education Commission in 1964. Kothari wanted to overhaul the education system of the country emphasizing holistic development of future generations of the country. Prem Kirpal, in his tribute to Kothari, has summarised the major recommendations of the Commission [6] as:

- (a) Introduction of work-experience and social service as integral parts of general education at all levels of education;
- (b) Stress on moral education and inculcation of a sense of social responsibility;
- (c) Vocationalization of secondary education;
- (d) Strengthening of centres of advanced study and setting up of a small number of major universities which should aim at achieving the highest international standards;
- (e) Special emphasis on the training and quality of teachers for schools;
- (f) Education for agriculture, and research in agriculture and allied sciences; and
- (g) Development of quality or pace-setting institutions at all stages and in all sectors.

These recommendations are as relevant today for the country as they were when the Commission made them. Unfortunately, only a few of the recommendations were implemented as the system was not dynamic enough to accept the revolutionary changes. One of them was the 10 + 2 + 3 system as we know it today, and probably more importantly, the introduction of



science and mathematics as compulsory courses for every student up to 10th class. UNESCO, however, used this report as a model for launching the International Commission on the Development of Education in 1971. He continued as a member of the Central Advisory Board on Education till the time of his death on 04th February 1993.

In later years, Kothari was concerned that what was expected was not achieved and felt that what was lacking in the report was a primary emphasis on the building of character in our education system. Kothari strongly believed that instructions should be imparted to the students in the regional languages, and he accepted to be the Chairman of the Commission for Scientific and Technical Terminology of the Government of India which was formed to lay down guidelines and principles for the evolution of scientific and technical terminology in Indian languages. Kothari also played a crucial role in the process of central services recruitments of Government of India through reforms of the selection procedure of Union Public Service Commission (UPSC).

Kothari was showered with honours and awards in his long and distinguished career. But he would often decline an award if he felt it was not ethical for him to accept it. For example, when Delhi University wanted to award him DSc (*honoris causa*), he refused it as he was at that time a faculty member of the University. Similarly, he never agreed to accept any honorary degree from any Indian University during his long tenure as Chairman, UGC. In 1962, he was awarded Padma Bhushan and in 1973, Padma Vibhushan by the Governemnt of India. He was the General President of the Indian Science Congress in 1964. In 1966, he received the Shanti Swarup Bhatnagar Medal of the Indian National Science Academy (INSA). In 1973, he was elected Foreign Member of the USSR Academy of Sciences, Moscow. During 1973–74, he was the President of INSA, New Delhi. In 1978, he was awarded the Meghnad Saha Medal of INSA. Professor Kothari was a Fellow of the Third World Academy of Sciences, Trieste, Italy; a member of the Pugwash Conference, and a recipient of the award of the National Federation of UNESCO Associations in India. He was made the first Chairman of Commission for Scientific and Technical Terminology, Govt. of India. He served as Chancellor of Jawaharlal Nehru University (JNU), New Delhi from 1982–1992. Delhi University established the D S Kothari Centre for Science, Ethics and Education in his honour.

Nuclear Explosions and Their Effects published by the Publication Division, Ministry of Information and Broadcasting, Government of India, New Delhi in 1956 [7] was written by him at the behest of Jawaharlal Nehru. It was the first book on this subject in open literature, totally based on published data available at that time. It is a tribute to his scientific acumen and intuition that he could work out the essential effects of nuclear explosions at a time when most of the information was classified. The book was highly acclaimed internationally and has been translated into German, Russian, and Japanese. His other popular books are *Atom and Self* and

Knowledge and Wisdom, both collection of lectures delivered during his long innings.

D S Kothari was above all a great human being who symbolized the noblest traditions of Indian culture. He had the highest regard for truth and non-violence and practised them in his life. Despite his extremely busy schedule, he always had time and sympathy for anyone approaching him for advice. Kothari had in his life an approach that harmonized science and religion. He was strictly against anti-rational behaviour or reasoning but held that it was religion that provides us moral and spiritual insight that gives a meaning and purpose to life. In his Meghnad Saha Medal lecture in 1978 [8], he spoke on the complementarity of mind and matter drawing on parallels from physics. “That we need to know more about the atom, about the external world of space-time and matter-energy, is beyond question. But to ignore altogether the knowledge of the self can in the end only invite disaster. The foundation of duty and reverence is self-knowledge, and, not the atom, not the external world. Even to decide to dedicate oneself to science, this decision, is not a part of science. It is outside science. It is akin to some kind of religious faith.”

Suggested Reading

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