Anna Mani – A student remembers

'What are you waiting for? Go ahead, here are the keys of the laboratories' this was what Anna Mani told me when, as a new member of her group in the Instruments Division of the Meteorological Office at Pune, I hesitatingly suggested to her one evening, that I felt confident of designing an ozonesonde that works. Developing an Indian ozonesonde was her pet project, assigned to her by K. R. Ramanathan, as part of the International Geophysical Year (IGY). The year-old project had run into many hurdles. Our group succeeded in developing a viable ozonesonde within six months. 1 still vividly remember the first balloon launch of our ozonesonde on a September night from the spacious lawns of the met office at Pune. My colleagues G. P. Srivastava, V. Srinivasan and B. B. Huddar were assisting me that night. As the balloon ascended into stratosphere, the ozone levels dramatically started increasing and continued until the balloon burst. We were all excited and telephoned Mani at 2 a.m., something which nobody dared do those days. She was thrilled at our success. After many more soundings and successful international inter-comparisons at Germany the instrument became operational at the India Meteorological Department (IMD). Anna Mani was then the Director of the Instruments Division at Pune. My association with her continued ever since.

Anna Modayil Mani was born on 23 August 1918 in Peermedu, in Kerala. She obtained her B Sc (Hons) in 1939 from the Madras Presidency College. Her scientific career began with C. V. Raman at the Indian Institute of Science, Bangalore where she studied the fluorescence and absorption patterns and spectra of diamonds. She was proud of her association with Raman who greatly inspired her in all her scientific activities. Mani was fond of laboratory work and liked instrumentation. In 1945 she went on a troop ship to the Imperial College, London where she met Brunt. Since the Imperial College did not offer any courses in instruments, Brunt directed her to the British Meteorological Office where she spent the next one year at the Harrow laboratories of the Instruments Division of the Met office, studying the evolution of weather instruments, the maintenance of primary and secondary standards for different weather parameters and the calibration and standardization procedures. During this period, she visited several field observatories and manufacturers of meteorological instruments in England and Scotland to familiarize herself with exposure criteria for field instruments and observational practices. She also spent time at the National Physical Laboratory at Teddington to learn about standards and standardization. After three years she returned to India in 1948.

Independent India was full of opportunities and Anna Mani seized the challenges. She joined IMD at Pune as a

meteorologist in the Instruments Division headed by S. P. Venkiteshwaran, a man with a vision and boundless energy. Until 1945 even simple meteorological instruments used in India such as thermometer shelters and barometer backboards were being imported. Venkiteshwaran was determined to design and manufacture all meteorological instruments required for India within the country. He had set-up workshop with precision machinery at the met office and started manufacturing simple instruments like ordinary rain-gauges, evaporimeters, thermometer shelters, anemometers, wind vanes, etc. Self-recording instruments like thermograph, hygrograph, anemograph, etc. were under development. It is into this exciting environment that Mani landed with all her newly acquired expertise and her dreams of making India self-sufficient in weather instruments in the shortest possible time.

This was no easy task. Skilled manpower to operate the machinery was not available in the country. Jobs had to be got done with available manpower making quality control difficult to achieve. Mani never compromised on quality for quantity. Edison's famous words 'There is a better way to do it; find it' was her motto. In a few years she was able to train and assemble a core group of people with expertise in design, manufacture, calibration, installation and observation. This was a period of intense activity in the IMD instruments division. She believed in hard work and set the example to others. She had faith in the potential of Indian scientists and engineers and was quick to spot talent among them.

Those days, there was very little assistance available in the private manufacturing sector and almost everything about instruments had to be done in-house. Mani faced this challenge and steadily added facilities to the laboratories and by 1960 the workshop had a well laid-out tool room, foundry, sheet-metal shop, machine shops, carpentry, assembly shops and paint shops all under one roof. The machine shop had high precision jig boring and engraving machines besides a whole range of lathes and milling machines. The laboratory equipment were equally sophisticated. A special attraction was the wind tunnel facility. Calibration chambers for thermometers and hygrometers were set up. When it was realized that ultra-cold chambers were not commercially available for calibrating radiosondes these were developed and built in-house successfully by Huddar using cascade cooling systems.

Anna Mani concentrated those days on the development of autographic instruments like thermograph, hygrograph, thermohygrograph, barograph, anemograph, recording rain-gauge, etc. She standardized and prepared detailed drawings and technical manuals for nearly 100 different instruments. Simultaneously she helped the Indian Stan-

dards Institution to publish Indian standards for various instruments.

Having contributed to self-sufficiency in meteorological instruments, Mani now turned her attention to solar energy as an alternate source for a tropical country like India. However data available on seasonal and geographic distribution of solar energy in India was limited. Thanks to K. R. Ramanathan, India was playing an important part in the International Geophysical year (1957–58). With growing interest in atmospheric physics that IGY brought about, it was decided to set-up a network of stations for solar radiation measurement. Initially the stations were equipped with imported instruments. But Mani took up the design and manufacture of a whole range of solar radiation instruments including sophisticated pyrheliometers, pyranometers and pyrgeometers. The number of radiation stations gradually increased to 35 by 1970. Calibration and standardization procedures for these instruments were set-up according to world standards. Pune was recognized as the regional radiation centre for Asia. Radiation data collected from the network was scrutinized and published from the world radiation data centre at St. Petersburg. Ommen Chacko and V. Desikan played important roles in establishing the radiation network. The international community of radiation scientists were quick to recognize Mani's phenomenal contribution to radiation measurements in the tropics and she was made chairman of CIMO working group on radiation instruments and subsequently as a member of the International Radiation Commission.

Anna Mani believed that wrong measurements are worse than no measurements and insisted that instruments are properly designed and built, accurately calibrated and correctly exposed and read. She clearly understood and supported the role played by WMO in ensuring standardization of all types of meteorological instruments, both ground-based and balloon-borne. Her obsession with quality of meteorological data made her influence WMO to some extent. She was directly or indirectly associated with international instrument companies since 1956 and ensured that international and inter-regional comparisons of all types of instruments were regularly carried out. In this process she helped WMO to designate international and national standards for almost all meteorological parameters.

Around 1960 Mani turned her attention to measurement of atmospheric ozone. Looking back, this was a remarkable vision, because the important role played by atmospheric ozone in shielding all forms of life on earth had come to light only two decades later. With K. R. Ramanathan's encouragement she undertook the development of an Indian ozonesonde. After this successful mission, regular ozone soundings were commenced from three Indian stations and from Antarctica from 1983. It is to her credit that India was among the five countries in the world to have its own ozonesondes. The data collected by the Indian ozonesonde over two decades enabled a clear picture of the seasonal and geographical variation of ozone in the upper atmosphere over the tropics. She helped to publish a number of papers on the ozone climatology over the tropics in reputed journals.

India had an excellent network of five total ozone measuring stations using the original Dobson spectrometers and even after 50 years these were unmatched in their accuracy. However, some of the mechanical and electronic systems could be simplified with modern designs and she undertook this task. One of the spectrometers was designated the national standard and satisfied international comparisons. Between 1975 and 1985 when global concerns were expressed about the possibility of a man-made catalytic destruction of atmospheric ozone following the classic paper by Rowland and Molina, the ozone community realized the importance of reliable ozone data and Anna Mani was right there in the centre-stage. WMO was quick to recognize this and she was made a member of the International Ozone Commission. In 1985 when Farman published his historic paper about the discovery of the 'ozone hole' over Antarctica, India was already involved in regular ozone soundings from Antarctica and these dramatically confirmed the existence of the ozone hole. It is well known how this discovery confirmed the worst fears expressed by Rowland and Molina (who jointly won a Nobel prize for their work) about the catalytic destruction of atmospheric ozone by man-made pollutants. Governments were alerted about the danger to the atmospheric ozone, the public were educated and ozone-destroying refrigerants replaced with ozone-friendly ones and the entire refrigeration technology re-invented and re-engineered. These were thrilling moments for Mani and for those of us who were involved in the ozone project.

In 1963, Vikram Sarabhai requested her to set-up a meteorological observatory and an instrumented tower at the Thumba rocket launching facility. The observatory was set-up and regular observations commenced. Tower instrumentation was something totally new to her and she persuaded the Overseas Communication Service to dismantle one of their 200 ft towers at Pune and re-install it at Thumba. The tower was ready two days before the scheduled launch of the first rocket. Wind instruments had to be fixed at five different levels on extendable booms and connected to the panels set-up in the control room. The data was vital for wind-weighting to determine the elevation and azimuth setting of the rocket. The question was who will climb the tower and install the equipment. When she left for lunch my colleague C. K. Chandrasekharan coolly went to the foot of the tower signalling me to follow. The ladder was outside the tower frame and the climb, absolutely scary. We climbed to the top without pausing. Instruments were commissioned in time. It was one of the thrilling moments we experienced together. Everything went well and there was jubilation all round when the first rocket thundered into the clear blue morning skies.

Anna Mani retired as the Deputy Director-General of Instruments in IMD in 1976 but was busier for the next two decades. She spent three years with Raman Research Institute in Bangalore helping them set-up a millimetre-wave telescope at Nandi Hills. Then, at the request of the Department of Science and Technology she prepared the *Handbook of Solar Radiation Data for India* (1980) and *Solar Radiation over India* (1981). These two volumes have become the Bible for scientists and engineers engaged in the design and deployment of solar thermal systems. This was followed by another phenomenal contribution: the Wind Energy Data for India (1983) prepared for the Department of Non-Conventional En-

ergy Sources. During its preparation she realized that for a realistic estimate of wind energy potential for the country, systematic observations from a large number of carefully identified locations were necessary. She organized round-the-year wind measurements from over 700 carefully identified sites spanning the whole country, using state-of-the-art equipment and a group of dedicated scientists led by S. Rangarajan. The special set-up created for this purpose under the Indian Institute of Tropical Meteorology still functions at Bangalore. This work resulted in the publication of *Wind Energy Resource Survey in India*, a monumental publication of immense value for scientists and engineers working in the wind energy. In the light of her results, wind-farms have been set-up at many places in the country.

Although she belonged to an ancient Christian church, she was an agnostic. She never distinguished between people of different faiths. Nature was her passion. She loved going to mountains, to the sea, enjoyed bird-watching, reading, and listening to music. She was emotional and sensitive to the sufferings of others. She loved dogs and always used to keep one or two with her. She had friends from all walks of life all over the world. She was a good communicator and made conscious effort to keep in touch with her friends.

Now to her academic distinctions. She served as President of the Current Science Association from 1989 to 1994 and was instrumental in the steps taken around 1990 to improve the quality and contents of *Current Science.* She was elected (1960) to the Indian Academy of Sciences, served on its Council (1971–79), was one of its Secretaries for 3 years and edited its Newsletter *Patrika* from its inaugural issue (1980) until 1995. She was elected (1977) to the Indian National Science Academy and served on its Council (1982–84). She was also a Fellow/Member of the Indian Meteorological Society, American Meteorological Society, American Geophysical Union, Royal Meteorological Society, Institution of Electronics and Telecommunication Engineers, Solar Energy Society of India, and International Solar Energy Society. She received the INSA K. R. Ramanathan Medal (1987).

She was a spinster. In 1994 she suffered a stroke and remained immobile for the rest of her life. She passed away on 16 August 2001 at Thiruvananthapuram.

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