ANNA MODAYIL MANI

(23 August 1918 - 16 August 2001)

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Anna Mani.

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(1918-2001)

Elected Fellow 1977

One test is worth ten thousand opinions. **ANNA MODAYIL MANI** used to repeat this very often. This was one of her guiding spirits. Major part of her working life was spent in meteorological instrumentation in the India Meteorological Department (IMD). After retirement from IMD, she worked in the Raman Research Institute and later in collaboration with the Indian Institute of Tropical Meteorology (IITM), set up the Wind Energy Survey Project for the Department of Science and Technology (DST). She headed this project almost till the end of her life.

FAMILY BACKGROUND AND EDUCATION

Anna Mani was born on 23 August 1918 at Peerumed, located in the Western ghats, in Kerala. Her father was an Engineer with the erstwhile Travancore Public Works Department, in charge of roads and bridges. Her mother was a teacher. Anna was the seventh of the eight children, five boys and three girls. The family belonged to the ancient Syrian Christian church, said to have been established in the year AD 52 by St. Thomas, Apostle of the East. However, her father, according to her own admission, was an agnostic and greatly influenced her own attitudes towards religion. He had also greatly influenced her thinking and philosophy. It was her rationalist father who taught her to be objective in her thinking and not to accept any statement unless she had tested and proved it for herself. She was always proud of her family and of the State of Travancore, with its rolling hills on the east, evergreen tropical rainforests, perennial rivers, endless backwaters and a long coast line washed by the Arabian sea in the west. She considered Travancore (now part of Kerala) to be one of the most beautiful places on earth. Holidays in early childhood were spent mostly in the mountains, where her father owned cardamom estates. Young Anna used to wander in the forests studying trees and watching birds and wild animals. This early exposure led to a love of nature in all its glorious manifestations, which she kept alive throughout her life.

Education

Her father's job meant that the family moved quite often and so she had frequent changes of school. Her earliest schooling was at His Highness the Maharaja's School for Women at Tiruvananthapuram. Later she attended the Christava Mahilalayam School for Girls at Alwaye. For her higher education she went to Madras (Chennai); the first two years at the Women's Christian College and then a three year Honors degree course in Chemistry and Physics at Presidency College, Chennai. She was taught Physics by Professor H Parameswaran and Chemistry by Professor BB

Dey, both very well known in their fields. During these years she took special interest in working in the laboratories and the workshops, where she used to enjoy doing things with her own hands; an interest she sustained throughout her life. She was interested in pursuing a career in research and this led her to the Indian Institute of Science, Bangalore, where she enrolled for research in 1940, in the Department of Physics, which was headed by Sir CV Raman.

Anna Mani was always very nostalgic about her stay in the Institute of Science. She was a great admirer of Raman and had built a special relationship with Raman and Lady Raman, who in turn treated her like their daughter. Their house was like a second home to her, not only while she was a research student at Bangalore, but also in later years. At the institute she was one among a team of nearly twenty students, investigating the various aspects of the structure and physical properties of crystals. Her initial work was on the fluorescence and absorption of light in rubies. In later years the team realized that they had just missed discovering the ruby laser. Her first paper was published in 1942. From rubies she graduated to work on diamonds. She studied the fluorescence of diamonds in the green as well as in the blue and related the fluorescence to the crystal's vibration spectra. The team's major contribution was the discovery of the mirror-image symmetry of the fluorescence and absorption spectra.

PROFESSIONAL CAREER

After nearly five years at the Institute, she was awarded a scholarship by the Government of India to study meteorological instrumentation in the United Kingdom. As it was felt that there was a need for expertise in this domain, she accepted the scholarship and went to England in a troop ship. She spent the next three years in England and was trained in all aspects of weather instruments by the British Meteorological Office. During this period she toured Briton extensively, visiting a number of meteorological stations in England and Scotland, including the magnetic and seismological stations at Eskdalemuir. She also spent three months at the National Physical Laboratory at Teddington, learning about standards and standardization. She also visited the different meteorological instrument manufacturers. Armed with this newly acquired expertise she returned to India in 1948, by which time, India had become independent.

Soon after returning to India, she joined the Instrument Division of the India Meteorological Department (IMD) at Pune. The Instrument Division was headed by SP Venkiteshwaran, a man who was and bent upon making India self-sufficient in meteorological instruments. He was a great organizer and was already in the process of setting up a modern instrument manufacturing facility, which included a top class workshop along with testing and calibration facilities. It was a unique workshop; in the sense the raw material goes into the workshop and the finished product comes out ready for calibration. In order to understand the philosophy behind such a set up, one has to remember that those days practically no small-scale industries were available within the country where components of instruments could be made as it is done today. So if one was keen to manufacture the instruments within the country, the only way to do it was to manufacture each and every item under one roof and then assemble them to make the final instruments. Thus, the workshop, which Venkiteshwaran set up had every conceivable shop like foundry, milling, turning, jig boring, sheet metal, plating, painting, carpentry and packing shops. Almost all the machinery was imported and world-class. The jig boring machines were the envy of industries in Bombay and Pune. Even they used to make use of the

facility at times. However, trained manpower for operating the machines was scarce in the country. There were very few industrial training institutes in the country at that time. Anna Mani soon realized that she had a stupendous task ahead but she was determined to succeed. Those days the instruments division at Pune used to manufacture the fan-type radiosondes and the ground equipment for receiving the signals from the radiosondes as well as simple raingauges, anemometers and wind-vanes. Her first job was to construct a recording rainguage. This was followed by hygrograph, thermograph, barograph, anemograph and so on, nearly one hundred in all. She prepared detailed engineering specifications, drawings, and technical manuals for all the different types of instruments. In five years' time imports of all surface instruments were completely stopped. BB Huddar played an important role during these years with his versatility, dedication and capacity for hard work. She now turned her attention to the establishment of primary standard instruments and techniques for the measurement of pressure, temperature and wind. Accurate measurement of pressure was the fundamental requirement of all weather services. She took up the job herself, toured all over the country and set up a series of regional standard barometers, inter-comparing them with the primary standards kept at Pune and Kolkata.

Then came the International Geophysical Year (IGY) 1957-58. As president of the International Association of Meteorology and Atmospheric Physics (IAMAP), KR Ramanathan (who after retirement from IMD had become the Director of Physical Research Laboratory, Ahmedabad) was intimately involved with the planning and co-ordination of the IGY. It was Ramanathan who inspired Anna Mani to take up the challenging task of setting up a dense network of solar radiation measuring stations covering entire India. In 1957, India had not yet started producing radiometers (for continuous measurement of radiation). Time was the essence and it was decided to participate in the IGY programme with radiometers obtained from Europe. With these instruments four radiation stations were established in 1957. Simultaneously she took up the daunting task of designing and developing the entire range of radiation instruments in the Pune facility. The instruments included the pyrheliometers, the pyranometers and the net pyrgeometers. These high precision instruments, were till then, the monopoly of the western countries and most of the design parameters were kept secret. So one had to start from fundamentals and develop the entire technology oneself. Some of the essential raw materials had to be imported. She was assisted in this task by Ommen Chacko.

The first radiation instrument to come out of the Pune laboratories was the pyrheliometer. This was soon followed by the pyranometer and later the pyrgeometer. Once the instruments were standardized, regular production started and soon enough India was in a position to enlarge its network of radiation stations.

In the mean time, after a short posting at Delhi, she returned to Pune to continue her work. She was sent to United States of America for training for seven months (1959-60) under Technical Cooperative Scheme. There she visited scores of institutions, laboratories and factories and had a good exposure to new ideas and manufacturing techniques. Many of these techniques were later on put into practice in the IMD workshops.

After Venkiteswaran's retirement, the mantle fell on Anna Mani's shoulders and she carried it with aplomb. She took pains to see that all meteorological instruments manufactured are of the highest quality and reliability. And she had established strict control over the rigorous tests, calibration and approval procedures. She wrote and brought out detailed instruction manuals on each type of

instrument in use in the observational network in India. She also prepared painstakingly a complete set of engineering specifications for every instrument made in Pune.

Monitoring of solar radiation was being made at various centers all over the world. But there was no common reference base for these data. The instruments used had different characteristics; the method of observations varied from center to center, no continuity in data collection was being enforced and even the units and terminology were not uniform. Thus the data were not directly comparable either. Under the International Geophysical Year (IGY) 1957 programme, many of the observational programmes involved in geophysics and meteorology were streamlined and uniform procedures were put into practice. Measurement of solar radiation also came under this programme and strict compliance was enforced.

Anna Mani and Chacko worked out the details involved and trained a band of field workers to carry out the field management of instruments, measurements and data evaluation. These data were later scrutinized at Pune. The duo laid down stringent procedures for field calibration of the instruments and the auxiliary equipment. The data generated were of such high quality, that the World Meteorological Organization (WMO) and the world scientific community took note of it. As a result, Pune was recognized as a Regional Radiation Center for Asian Region. The Commission for Instruments and Methods of Observations (CIMO), of the WMO had its 3rd Session at New Delhi in 1962. During this Session Anna Mani was chosen as the Chairman of the Working Group on Radiation Instruments and Observations and as a Member of the Working Group on Special Radiation Instruments and Observations. In the meantime she was also appointed as the Chairman of the Working Group on Radiation for Regional Association-II (Asia).

Anna Mani served two terms as the Chairman of the Working Group on Radiation for RA-II. During this tenure she arranged to make a Survey of Radiation Activities in Asia and prepared a report during 1964-1968. The report was updated in 1970. The reports involved laborious work in eliciting response from different countries, which included even the then USSR and China and the meticulous care taken to eliminate all possible errors. This survey has not been repeated again even today in 2002. As chairman, she interacted closely with the Japan Meteorological Agency and WMO and arranged for an intercomparison of the two Regional Standard Pyrheliometers maintained at the two Regional Centers, Tokyo and Pune. This took place in Pune during January 1964. Realizing the problems involved in the individual participation in intercomparisons of radiation instruments at a specific center by the Member countries- most of them being developing or underdeveloped countries with severe financial constraints, Anna Mani arranged to send Chacko to Tokyo, Seoul, Hongkong, Saigon, Bangkok and Colombo with the standard pyrheliometer based at Pune and got the radiation standard instruments at these centers compared and calibrated during February-March 1970. Thus these instruments were compared with least expenditure to the Member Countries and to WMO. Anna Mani's tenure as Chairman of Working Group on Radiation and as a member of Working Group on Special Radiation Instruments saw a flurry of activities.

PROFESSIONAL AND SCIENTIFIC CONTRIBUTIONS

Different types of radiation instruments were being intercompared but mostly in Europe and in USA. These instruments, mainly the pyranometers, are exposed in network stations all through the year

and subjected to the rigors of weather and its rapid changes. The temperature and wind shocks are regular features on these instruments. Realizing that the performance characteristics of the instruments would not be the same under different climatic regimes, Anna Mani took pains to convince her colleagues in the Working Group and the WMO to organize a series of long-term intercomparisons of three types of radiation instruments. They are the sunshine recorders, the thermoelectric pyranometers and the net pyrradiometers. The intensity in the Working Group's activities had to be seen to be believed. She, with the concurrence of the experts selected the specially and carefully made Casella model of sunshine recorders as Interim Reference Sunshine Recorders (IRSR) and the sunshine cards used in France as reference cards. She enlisted the cooperation of as many as 58 member countries to participate in the comparisons. The IRSR's procured by the members were installed alongside the national field instruments in the national network and the duration of sunshine hours obtained from the two compared. The intercomparisons were conducted from 1964 to 1968. The efficiency of Anna Mani's working culminated in publishing the findings as a report to the CIMO-V held in 1969.

The intercomparisons of pyranometers were carried out at three centers, St. Petersburg (then Leningrad), Vienna and Pune. The persuasive capacity of Anna Mani was at its best when the then USSR not only agreed to undertake the comparisons but also to provide their Yanichevski pyranometers for the comparisons, though of course in exchange for other makes. The comparisons were held during the 1964-1967 period. In all, five types of pyranometers were installed side by side under identical exposure conditions. Day-to-day maintenance was also ensured. The guidelines stipulated in-situ calibrations at least once a month for different solar elevation angles. This was also complied with at each of the stations. Again, the final report on the results was presented at CIMO-V.

The intercomparison of the net pyrradiometers was more challenging due the nature of parameters to be measured and the inherent inability of instruments to record the true values. Five different types of instruments participated. The then USSR was again roped in. The comparisons were carried out at four centers: Aspendale, Pune, Hamburg and St.Petersburg (then Leningrad), during 1964-1967 period. The routine maintenance and the extended monthly calibration of the instruments involved were strictly adhered to. Again the findings were ready for CIMO-V. The most important intercomparisons in the radiation field are that of the standard pyrheliometers. The differences in geometry of different pyrheliometers then in use gave differing irradiance values for the same energy level from the same source when simultaneous measurements were made. IUGG and WMO had worked out a solution by defining a scale called the International Pyrheliometer Scale 1957. All the radiation measurements made earlier were adjusted to this scale and measurements made since IGY were according to this scale. To ensure the stability of this scale, WMO organizes intercomparisons among the Regional Standard pyrheliometers once in 5 years. The first International Pyrheliometer comparisons (IPC) was held in 1959. The second and third were held in 1964 and 1969 at Davos, Switzerland. Anna Mani as Chairman and as a radiation expert was unanimously chosen as the technical director during these comparisons. She carried out this responsibility with her usual aplomb. During the 1969 IPC Anna Mani and other experts noticed some drift in IPS(1957) and started looking for remedial measures and scientific explanations. The absolute cavity radiometry based on self-calibrating electrical fundamental units was coming into vogue around this time.

The Working Group recommended that IPS 1957 should be evaluated again and if necessary replaced after a large number of specialized and precise measurements were carried out with these cavity radiometers. They were proved right when a new reference, World Radiometric Reference (WRR) replaced IPS-1957 in 1980. She was also personally responsible for the WMO designating the Physikalisches Meteorologisches Observatorium, Davos, Switzerland, as the World Radiation Center and St.Petersburg as the World Radiation Data Center.

Despite these hectic activities, Anna Mani had time for another important radiometric study. Professor Byron of University of Wisconsin, during a visit to New Delhi, was appalled to note (from his aircraft) the thick dust layer in the troposphere over the northern India. Anna Mani readily invited him and his associate Peter Kuhn to conduct a series of balloon-borne radiometric studies in the atmosphere over the region. They brought their radiometers and Anna Mani provided the necessary support and equipment and conducted radiometric soundings from three sites, Pune, New Delhi, and Srinagar, during 1963. This gave Anna Mani an opportunity to get their consent for developing radiometers based on their designs and thus was borne a new measurement schedule - fortnightly radiometer soundings after sunset initially at four places: Pune, New Delhi, Srinagar and Tiruvananthapuram. Now these measurements are made at nine stations. She also managed to carry out an intercomparison of these radiometers with those by Japan Meteorological Agency at Delhi.

During all these manifold and absorbing activities, she did not lose sight of her primary concern of indigenous manufacture of radiation instruments and achieving the network strength of 14 radiation stations envisaged under the IGY Programme. By 1969 when she moved to Delhi on becoming Deputy Director General of Observatories for Instruments, the Indian network had 24 radiation stations, thanks to her initiative and drive and to the sincere and devoted team of scientists including Chacko and Desikan. The standard of the network maintenance and the quality of data generated attracted the attention of leading scientists in the field. Pune became a training center in radiation work for Member Countries in Asia and Africa. She was a long-term member of the International Radiation Commission of IUGG and regularly participated in its International Radiation Symposia. She also helped in the formation of Indian Solar Energy Society and actively participated in all its activities.

She was also a member of the committee on meteorological instruments of the Bureau of Indian Standards. She actively participated in its deliberations and prepared technical specifications and engineering drawings of many instruments so that entrepreneurs may be able to make meteorological instruments in India. She also undertook total replacement of all network meteorological instruments based on British FPS system by instruments based on metric system when India adopted the metric system. Accordingly, all the instruction manuals and engineering specifications along with their drawings were revised. Pune workshop also had to be re-equipped to suit the metric system. This was one of the most difficult tasks in her many accomplishments and a great legacy to India Meteorological Department. In these tasks she was ably assisted by R Choudhury, S Gopinath and BA Kalyankar.

CIMO-III at Delhi had also included her as a member of the Working Group on International Precipitation Gauges. Many countries participated in the comparisons conducted during 1962-1965. The Working Group got ready a standard precipitation gauge- the Interim Reference Precipitation Gauge [IRPG]. She also lent an active hand in the conduct of International Comparisons of

Evaporimeters, arranged by the CIMO Working Group on Evaporation. She was also a member of the CIMO Working Group on Atmospheric Electricity from 1962 to 1969. Her Working Group on Radiation had prepared a revised draft of Chapter IX of CIMO Guide on Meteorological Instruments and Methods of Observation. This was adopted by CIMO-V.

In addition to her organizational and technical capabilities, she had a strong aptitude for research work as evidenced by her numerous research papers in Indian and foreign journals. She liked to plan and execute practical measurements involving research studies. She personally led a team of her scientists to Gulmarg and Khilanmarg in Kashmir for making special measurements of various parameters of radiation and atmospheric electricity at high altitude locations at 3000m and above. She was ably assisted in these ventures by G.P.Srivastava and V.Srinivasan. She took keen interest in making special measurements of global and reflected solar radiation measurements on aboard aircrafts during 1972 and 1974 from airbases at Bangalore, Pune, Agra and Varanasi to determine the effect of different air layers and the albedo of various clouds and land surfaces. She had also made successful measurements of global and reflected radiation on board ocean going research vessels over Indian waters, using gimbal-mounted instruments.

Such manifold and successful contributions in a variety of disciplines made WMO to entrust the revision of the entire CIMO Guide on instruments for its fourth edition. She carried out this assignment creditably in the stipulated time of six months. She was on deputation to Egypt as radiation expert for training of the radiation staff in the Meteorological Office at Cairo. She sustained her interest in radiation work even after her retirement from the government service. She continued to attend International Radiation Symposia at various centers and contributed significantly to improve radiation measurements on a global scale.

While she was busy in establishing the network for the measurement of solar radiation, Anna Mani's attention also turned to atmospheric ozone. Professor Ramanathan was the president of the International Ozone Commission. He had all along been deeply involved with the study of atmospheric ozone and firmly believed that all forms of life on earth were in delicate equilibrium with the atmospheric ozone, not withstanding the fact that ozone molecules formed only a few parts for every 100 million air molecules. He had acquired a Dobson spectrophotometer for the Physical Research Laboratory and had number of students working on ozone research. He was also responsible for IMD setting up a network of 4 Dobson's at various locations in India. He inspired Anna Mani to standardize and recalibrate all the Dobsons in India so that the 'total ozone' data collected from the network becomes compatible with the global data. Simultaneously, he also urged Anna Mani to develop an Indian ozone-sonde for the measurement of vertical distribution of ozone up to 35 km above the ground. Professor AW Brewer of Clarendon Laboratories, Oxford University, had already successfully developed an electro-chemical ozone-sonde in 1957. Among the different types of ozone-sondes, the Brewer sonde was considered to be the most reliable and Anna Mani took up the challenge of developing a similar ozone-sonde in the Pune Laboratories in 1962.

She was assisted, initially, in the project by EL Simmons, a lecturer in Physics, in Wilson College, Mumbai who, incidentally, happened to be Brewer's student in Oxford. The instrument was somewhat complex. As the sonde is carried aloft by a slowly ascending balloon, the ambient air is sucked in at a steady rate by a miniature pump and bubbled through potassium iodide solution. Every molecule of ozone liberates 2 atoms of iodine, which in turn transports two electrons across

the sensor. This feeble signal modulates a transmitter attached to the instrument and the signal is tracked and recorded on the ground. The vertical profile of ozone is then worked out from the recorded signal. Despite a series of initial failures, she pursued the project undaunted and in September 1964, produced the first successful ozone-sounding from Pune. During the next five years the sonde was improved to such an extent that systematic soundings were started from Tiruvananthapuram, Pune and New Delhi. In 1970 the Indian ozone-sonde participated in the International ozone-sonde comparisons held in Hohenpiessenburg in Germany. The sonde came out with flying colors in the comparisons. The frequency of the soundings from India were doubled and a clear picture of the vertical distribution of ozone over the tropical latitudes emerged from the soundings. Around the same time there was global concern about the possibility of the fragile ozone content of the atmosphere being selectively destroyed in a catalytic reaction involving cloroflurocarbons (CFC), which are let out into the atmosphere by human activity. In 1975, Rowland and Molina published their theory about catalytic destruction in a short paper but were effectively silenced by the CFC manufacturers' lobby.

The breakthrough came ten years later, in 1985, when Farman published his discovery of the 'ozone hole' over Antarctica, the proof that there is unmistakable evidence of catalytic destruction of atmospheric ozone. Rowland and Molina were resurrected and subsequently won the Nobel Prize for their work. Global efforts were hastily mobilized for the systematic measurement of atmospheric ozone. Luckily, India was fully prepared, thanks to Anna Mani and Ramanathan, to meet this challenge. Indian ozone soundings had become a routine part of the Indian scientific expeditions to Antarctica from 1982 onwards, almost three years before Rowland and Molina published their paper. The Indian ozone sounding clearly showed the 'ozone hole' over Antartica and corroborated Farman's discovery. Subsequent events, like the Montreal Protocol and the replacement of the harmful CFC's on a global scale, with ozone friendly chemicals is part of history. No one was more excited than Anna Mani as she witnessed these developments. The Indian ozone-sonde which was her brain-child was successfully intercompared in 1980 from Germany and again in 1991 from Canada. CR Sreedharan and G Venugopal were mainly responsible for the Indian ozone-sonde in its current form. The sonde is regularly flown from Tiruvananthapuram, Pune, New Delhi and Dakshin Gangotri, Antarctica. The soundings have yielded an accurate picture of the vertical distribution of ozone in the tropics and its temporal and spatial variations. The soundings over Antarctica have provided clear evidence of the dramatic ozone depletion over Antarctica during September-October. The Indian ozone soundings assume special significance because India is the only country conducting systematic ozone measurements from the tropical region. All other countries that make ozone soundings do it from the middle and high latitudes.

In 1976, she retired from IMD and joined the Raman Research Institute in Bangalore as Visiting Professor for three years and joined the group engaged in setting up the mm wave telescope at RRI campus and at Nandi Hills near Bangalore. Using newly developed infrared spectral hygrometer and radiosonde data she made extensive measurements of perceptible water content over Nandi Hills and Bangalore and established that the mean perceptible water content over Nandi Hills is only 5-6 mm as against 35-40 mm at Bangalore.

In the mean time, the Department of Science and Technology approached her for organizing extensive measurements all over India for assessment of the potential resources in solar radiation

and wind energy in the country. This led to the publication of two exhaustive volumes on solar radiation over India; The Handbook of Solar Radiation Data for India (1980) and Solar Radiation over India (1981). The first volume gives observed data at 18 stations and the second volume the computed data for 145 stations. Two approaches were employed; one using regression techniques to calculate global diffuse and direct solar radiation from records of sunshine or cloudiness and the other using a theoretical model to compute radiation received on the ground, taking into account scattering and absorption by known concentrations of oxygen, ozone, carbon dioxide and water vapor in the atmosphere. In this monumental work, she was assisted by S Rangarajan.

In the context of the emerging needs to harness the non-conventional energy sources in the country for augmenting the national power resources, the Ministry of Non-conventional Energy Sources, Government of India embarked in 1984, on a programme of assessing the wind energy potential over India. With her vast experience in this field and her organizing skills, Anna Mani was asked to undertake this task and she organized the wind energy survey project at Bangalore with a select small band of dedicated workers. The job involved, the identification of the best available, cost effective, automated wind instruments in the world; procurement of suitable, easily transportable rugged 20 metre masts; selection of sites for wind survey in far flung areas in the country in different states; installation and collection of data; retrieval and analysis of the data and publication of the results of the survey. On the more difficult managerial side, she had to co-ordinate the bureaucracy from different states with differing approaches to the programme. It was by no means easy. Commencing with a network of 21 stations spread mostly over Tamil Nadu and Gujarat in 1984-85, the activities expanded considerably during the subsequent years. At the time of her retirement from the project in 1996 due to deteriorating health, the network had collected valuable wind resource data from about 150 far-flung and at times difficult to access stations. Before retirement from the project she published in 4 volumes, entitled, Wind Energy Resource Survey in India, a detailed analysis of this data in a user friendly format. These volumes have now become the Bible for scientists and engineers involved with the conversion of wind energy to electrical energy and utilizing the information provided in these volumes a number of wind-farms have been successfully set up in various parts of the country.

AWARDS AND HONOURS

Coming to her academic distinctions, she served as the President of the Current Science Association (1989-94). She was elected to the Indian academy of sciences and served on its council (1971-79), was one of its secretaries for 3 years and edited its newsletter '*Patrika*' from 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 of the Indian Meteorological Society, American Meteorological Society, American Geophysical Union, Royal Meteorological Society, Institution of Instrumentation and Telecommunication Engineers, Solar Energy Society of India and International Solar Energy Society. She received the INSA K.R:Ramanathan medal (1987). The number of wind farms in various parts of the country with their giant propellers gracefully turning in the wind in a synchronized way, generating well over 1000 megawatts of electricity is perhaps the greatest tribute to Anna Mani and her immense faith in the great potential of our country.

AS A PERSON

Although she belonged to an ancient Christian church, she was an agnostic and never distinguished between people of different faiths. She continued her passion for nature and every living thing in it throughout her life – a passion she developed in her childhood. She was an avid reader and enjoyed listening to music. She was emotional and sensitive to the sufferings of others. She loved dogs and kept one or two with her always. She had friends and admirers throughout the world and she made a conscious effort to keep in touch with them. Anna Mani was a spinster. In 1994, she suffered a stroke, which rendered her practically immobile. The last few years of her life, she spent with her elder sister Chellamma Chandy, who took care of her till the very end. She passed away on 16 August 2001 at Thiruvananthapuram and true to her convictions was cremated in the electric crematorium there.

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