
**The newsletter of Indian Meteorological Society, Chennai Chapter**

**Vol. 11 - Issue 2, December 2008**

## Contents

Overview of Automatic Weather Stations in IMD - B.Amudha
Untold Promise of Zeus to Chandrayaan-1 - B.Amudha
Enjoying the art of exploring the beauty of nature - B.Geetha
Mapping the Maps - K.V. Balasubramanian
Midget Cyclonic storm "OGNI" – 2006 - R.Nallaswamy
Conservation of Angular Momentum and its application - R. Samuel Selvaraj,

## EDITORIAL

Dear Member,

I have the great pleasure in releasing this issue, Volume No. 11, Issue –2, of Breeze. I request you to send your valuable suggestions for further improvement.

There were a number of scientific activities since the release of last issue. I have summarized the events and also furnished the forthcoming events.

With a view to accommodate more contributions and on account of space constraints, I appeal to all the members to submit their contribution in 2 to 3 pages within the stipulated dates to avoid delay. We propose to bring out the next issue of Breeze by the end of June 2009. Articles may kindly be sent to The Editor before 31st March through email to ims.chennai6@gmail.com or rns115@gmail.com

The services of Shri K.V. Balasubramanian, AM II in preparation of this issue of Breeze is appreciated and acknowledged by the Editorial Board.

With Best Wishes,

**R.Nallaswamy**
Editor
December 2008
Chennai

---

Those who wish to become members of IMS can download the application form and the other details from the website of IMS Chennai Chapter.

E-mail : ims.chennai6@gmail.com

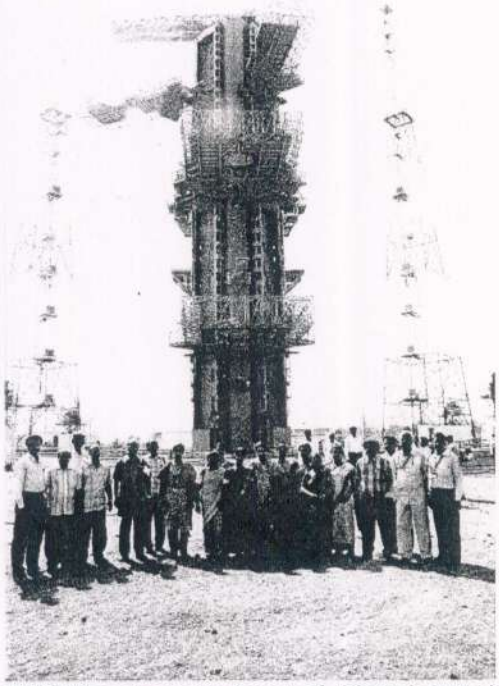
---

The Editor and the IMS-Chennai Chapter are not responsible for the views expressed by the authors.

Membership details of IMS-Chennai Chapter as on December 2008

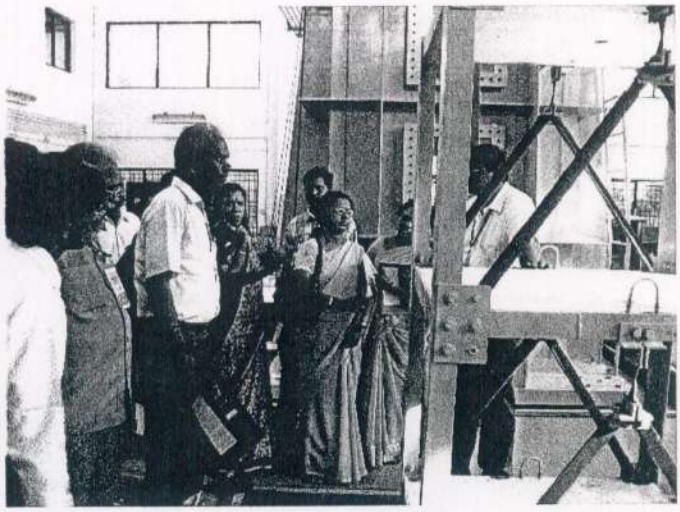
Life Members: 91 Ordinary Members: 67 Total : 158

IMS Members in the reception hall of Shriharikota Rocket Launching Station



IMS Members in front of New Launch Pad

IMS Members in SERC-A Scientist from SERC explaining the working of wind tunnel



A Scientist from SERC is explaining the working of Quake Testing Table.

# Overview of Automatic Weather Stations in IMD

B.Amudha[1]

## Definition

An Automatic Weather Station (AWS) is defined as a meteorological station at which observations are made through sensors and transmitted automatically. Automatic weather stations are used for increasing the number and reliability of surface observations. The spatial density of the observational network can be increased and availability of data beyond normal working hours is possible with the help of AWS. Use of modern and sophisticated technology ensures accuracy and reliability of measurements. Errors induced due to inherent limitations in the method of taking observations by different individuals can be avoided.

## Background

In the international scenario of AWS, most of the developed countries have gone in for automation in their surface observational system since early 1970s and countries like USA, Australia, China and many European countries are in the fore-front. At the same time, it should also be noted that no country has completely withdrawn their existing set-up of conventional surface observatories, though new manual and conventional observatories are not planned. Instead AWS are being installed to enhance their meteorological observational network and many countries have their AWS installed in Antarctica also for research purposes.

With an objective of progressing towards better technology and adapting to current trends, India Meteorological Department took a giant leap forward and had installed 100 INSAT 1B satellite-based Data Collection Platforms (now renamed as Automatic Weather Stations) all over India during 1980s which were functional till early 1990s. This first network of 100 DCPs provided valuable insights and revelations on the various challenges of maintaining a vast network of AWS which were located in remote sites, coupled with the duty to allay the apprehensiveness of forecasters on the dependability and assimilation of observations from such AWS sites into the operational forecasting set-up.

Under the modernization programme of IMD, in the initial phase, India Meteorological Department (IMD) installed an upgraded, state-of-art network of 125 Automatic Weather Stations (AWS) all over India during 2006-07 including one in Maitri, Antarctica. It was ensured that equipments of international standards are installed with the single-pointed aim of bringing about a commendable change in putting into place an additional operational tool for weather forecasting. The performance of the existing AWS network is being monitored closely and the data are very much reliable. Out of the 125 AWS in India, 100 AWS are of Sutron-make, USA and 25 are indigenous, Astra-make, Hyderabad. The indigenous make AWS have been installed on a test and evaluation mode. IMD network of Automatic Weather Stations is shown in Fig. 1. Automatic Weather Station(AWS) installed at CDR, Karaikal is shown in Fig.2.

Out of the existing 125 AWS, thirty five are located in RMC Chennai region. Tamil Nadu & Pondicherry have 11, Karnataka-5, Andhra Pradesh-13, Kerala -5 and Lakshadweeep-1. Data from all the AWS is being received and monitored round the clock at the satellite-based Receiving Earth Station installed at IMD, Pune.

## AWS equipments and transmission technique

Automatic Weather Stations use state-of-art data logger and transmitter with sensors interfaced for data sampling and recording. Meteorological sensors for Air Temperature, Relative Humidity, Atmospheric Pressure, Rainfall, Wind Speed and Wind Direction are interfaced with both Sutron and Astra make AWS. Apart from these parameters, at few selected Sutron-make

---

[1] Meteorologist Gr.II, RMC Chennai

AWS additional sensors for Global Solar Radiation, Soil Temperature and Soil Moisture have also been interfaced.

AWS transmit data in UHF frequency 402.75 MHz, every hour in their allocated time slots which is received by the Data Relay Transponder of the geostationary satellite Kalpana-1 and is retransmitted by the satellite at a downlink frequency of 4506.05 MHz to the Central Receiving Earth Station located at Pashan, Pune. The technique utilized for transmission is called Pseudo-Random Burst Technique (PRBS) where a defined number of AWS transmit three times in a 10 minute window allocated to them. The best of the three messages is decoded and displayed in engineering units.

The raw data received from all AWS is processed at the Earth Station and the synoptic data in WMO Synop Mobile FM-14 Ext format is transmitted to AMSS Mumbai via ftp through 64 kbps leased line which is then put to the Global Telecommunication System (GTS) by AMSS Mumbai every hour. The processed data is archived at Earth Station, Pune. Synoptic charts plotted at NHAC, New Delhi using data from AWS are available for forecasters in the site ***ftp://nhac@202.141.140.210.*** Feedback from NHAC, New Delhi indicates that the data from AWS are comparable and isobaric analysis of the charts plotted with data from AWS stations matches with the analysed chart of data from conventional surface observatories.

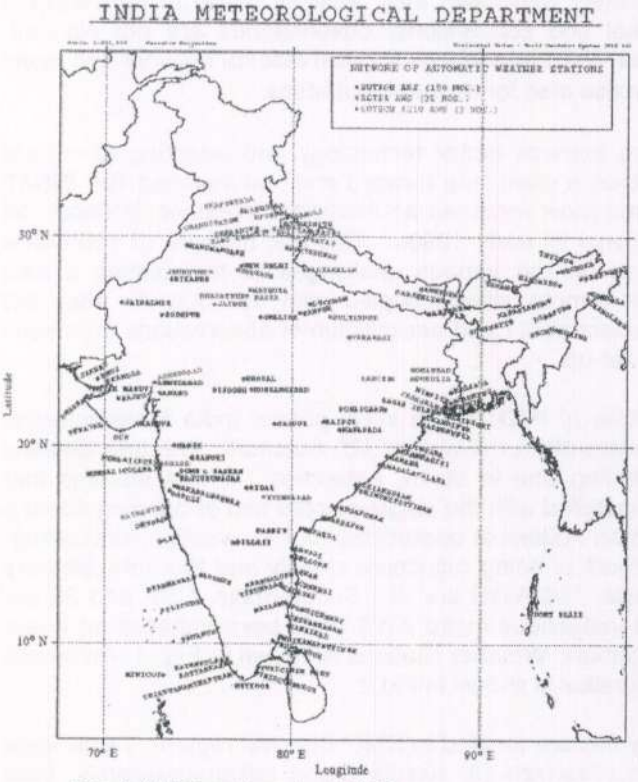



**Fig.1 AWS network of IMD**

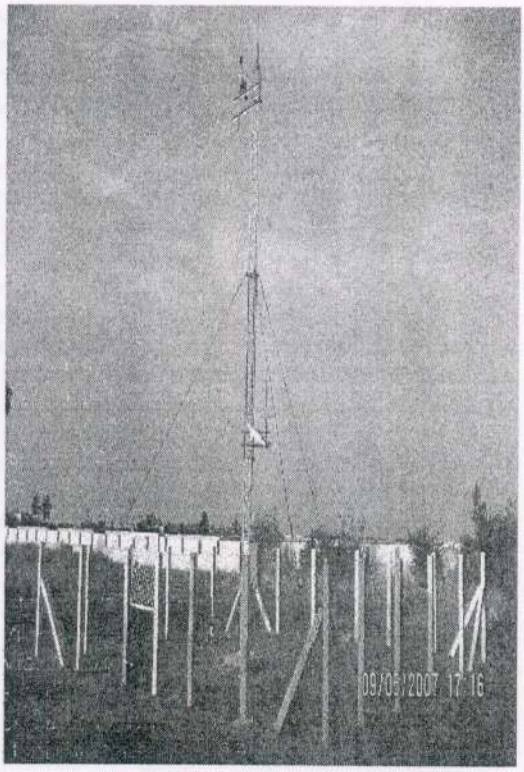



**Fig.2 AWS installed at CDR Karaikal**

AWS data is also being sent through radio modem from the Earth Station at Pashan, Pune to National Data Centre (NDC), Pune on a daily basis. Procedures for quality checking and archival of AWS data at NDC Pune have also commenced. The quality-checked AWS data is now being uploaded to the website and is available in *http://www.imdpune.gov.in/* with a lag of 24 hours. Efforts are being made to incorporate data from AWS into forecasting models.

## Advantages of AWS

The main advantage of AWS is that they are unmanned and provide accurate and reliable observations. Further, hourly data is available from AWS whereas conventional surface observatories provide data in three hourly intervals as per international standards. In fact AWS can be configured for any user-defined time interval for transmission with the limitation being only on power consumption, which may require additional higher capacity batteries and solar panels. Man-made errors in observations are eliminated in measurements with AWS. Accuracy and reliability of observations improves substantially. Periodic maintenance and calibration of sensors is a prerequisite to be ensured for crucial and dependable data availability.

Crucial data from AWS during adverse weather can be utilized when conventional observatories are unable to provide data at frequent intervals and when sufficient observatories are not located in a spatially representative grid square. Dependability on AWS in India has improved considerably and the preliminary results from the performance of the AWS during adverse weather in particular, have increased the confidence level on AWS as presently is the case in most other international meteorological agencies.

## Challenges for maintenance of the AWS network

Accurate and reliable measurements from AWS are possible only with properly calibrated sensors and periodic quarterly maintenance, prior to the onset of monsoon and preferably immediately after a depression / cyclone. Tropical rains are characterized by heavy downpours and when a cyclonic disturbance occurs, rainfall of very heavy intensity occurs. The rain gauge needs to be in good condition under such instances. The tipping bucket rain gauge has an inherent limitation of missing of pulses during very heavy rainfall and may underestimate the actual rainfall recorded. The tipping bucket may get stuck up in a neutral position if the reed switch mechanism is not functional.

Clogging of rain gauge due to leaves, twigs, fine mud deposits due to wind, bird droppings, may further lead to wrong readings. Hence periodic cleaning of rain gauge is necessary for obtaining accurate rainfall data. Regular upkeep of the AWS enclosure by clearing off the bushes and creepers is also a necessary condition. Safety and security of AWS equipments is very important considering the capital investment and the high probability of theft of solar panel, battery etc., for a paltry benefit considering the differences in economic standards of the Indian population. Unforeseen theft of equipments, battery, solar panel and other components of an AWS leads to non-functional status of an AWS and hence loss of data.

Awareness among the general public about the safety of AWS in the vicinity of their locality, valuable nature of weather data in general, and of adverse weather in particular, needs to be inculcated as part of the implementation of the project of commissioning AWS. Most developed countries having automatic weather stations in their forecasting network have realized these and other challenges which are not *unique* only to Indian conditions. Efforts are being made to overcome the problem areas and identify solutions for them as modernization is inevitable in the changing technological scenario.

## Augmentation of IMD network

The density of the surface observational network is proposed to be increased further by Commissioning 550 more AWS which includes 127 Agro-AWS in Agricultural Meteorological Field Units (AMFUs) for the Agro Climatic Zones of India. Agro-AWS will have sensors for leaf wetness, leaf temperature, soil moisture and soil temperature in addition to the standard sensors in an AWS. Procurement process has already been initiated and installation and commissioning of the AWS is expected to be completed by the end of 2009.

Procurement of 1350 Automatic Rain gauge stations (ARGs) is in the final stages and the first batch of ARGs is expected to be commissioned by Feb 2009. 500 ARGs will have sensors for air temperature, relative humidity and rainfall. It is proposed to have only rainfall sensor with the remaining 850 ARGs. Installation and commissioning of all 1350 ARGs is

planned for completion by the end of 2009. These AWS and ARGs are also satellite-based and will utilize Time Division Multiple Access (TDMA) technique for transmission from remote sites which will all have their unique GPS-synchronized time-stamps for transmission.

RMC Chennai region will also get its share of AWS and ARGs with the broad criteria being that each district shall have at least one AWS and two ARGs giving adequate spatial representation. The observational network is thus planned to be augmented and automated as part of the endeavours to be on par with developed countries in the field of Automatic Weather Stations. Data from remote and inaccessible terrains will be available to aid better forecasting of weather. Modernization phase will be taken up in stages and in the next few years, more number of AWS and ARGs are contemplated.

## Awareness and empowerment

The need of the hour is to empower and create awareness in knowledge-driven, self-motivated officers/staff of IMD without whose cooperation and support automated networks of this magnitude cannot be maintained successfully. Even if the equipments are under maintenance contracts, assistance and initiative of dynamic IMD staff in providing crucial inputs can go a long way in ensuring that the AWS/ARG stations in the vicinity of an observatory where he/she is employed is properly functional. The success of automation and modernization lies in such an empowered support system and IMD is also surging towards this vision to fulfill its prime mandate of providing accurate weather forecasting.

********

References


1. *World Meteorological Organization, 1992a: International Meteorological Vocabulary. Second edition, WMO-No. 182,Geneva.*
2. *Guide to Meteorological Instruments and Methods of Observation, WMO No.8,Sixth edition, 1996.*
3. *Vashistha R.D., Amudha B., Rudra Pratap, 2005, "Present status of surface meteorological observations in India", WMO TECO- 2005.*

# Untold Promise of Zeus to Chandrayaan-1

**B.Amudha**[2]

Dr. G.Madhavan Nair, Chairman of Indian Space Research Organisation (ISRO) said on 22 October 2008, "We have fought against many odds, including the weather in the last few days, to achieve this success", minutes after the successful launch of Chandrayaan-1 into space. Undoubtedly, on that golden day, India joined the elite club of five other countries which were successful in their lunar missions. The satellite entered into lunar orbit some 100 km above the moon's surface on 8 Nov2008.

It was the usually welcome active North East Monsoon rainfall coupled with thunder and lightning activity which was playing spoilsport since 18 Oct 2008. The feeble low pressure system in the Bay of Bengal and its associated lightning activity was the main cause of concern for space scientists. It was considered as one of the bottle necks in achieving their long-dreamt lunar mission. Nevertheless, with an indomitable spirit, the confident ISRO scientists went ahead with their countdown procedures for the launch of Chandrayaan-1. The destined day of the lunar mission dawned on 22 Oct 2008. The faith of the space scientists on their capabilities, intelligent calculations and technical expertise proved their brilliance and single-pointed aim in surmounting the barriers with skill and precision.

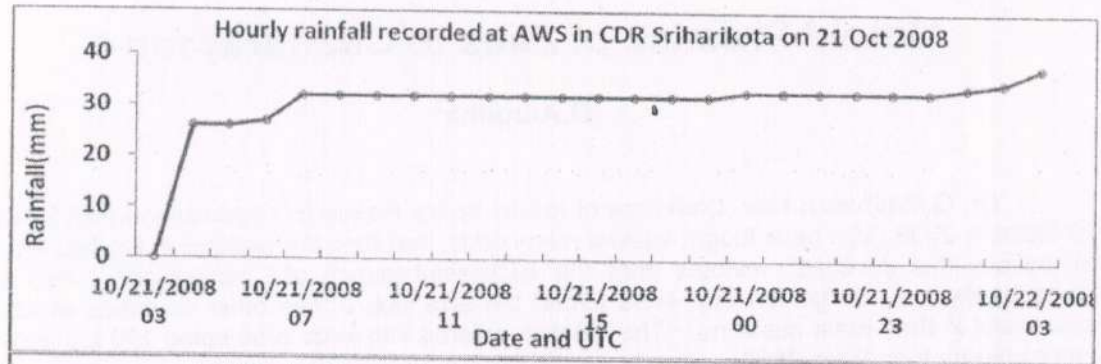
It was raining throughout the day on 21 Oct 2008 in Sriharikota and Chennai as well. But as the D-day dawned, the weather was so calm and controlled, though cloudy, giving a memorable ambience which I cannot forget in the years to come. It appeared that the rain God had an untold promise to be fulfilled and so as though it had relented fully, the early morning of 22 Oct 2008 dawned with a slight drizzle in Chennai. Being part of the meteorological community, I was eager to watch on television, the live telecast of the launch of Chandrayaan-1. I was praying like millions of likeminded individuals that the launch should be smooth, considering all the criticisms likely to be heard if ISRO failed in its mission.

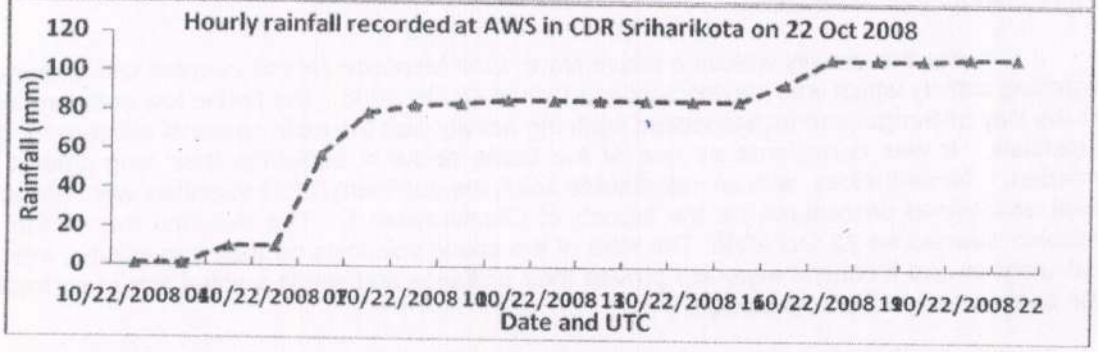
Chandrayaan-1 roared into space at the scheduled time of 0622 a.m completing all its scheduled tasks. It was a thrilling and proud moment as India entered into yet another glorious landmark! And then came the real splendour and opening up of Mother Nature! According to Shri. A.M.Kannan, Met. In-Charge, CDR Shriharikota (SHAR), IMD, rain started at 0625 am soon after the launch. Shri.Kannan and his team at SHAR had been providing valuable support by providing near real time radar pictures to the SHAR Launch Control Centre (LCC). He graciously parted with a radar picture of the cloud development taken on 22 Oct 2008 at 00:29 UTC.

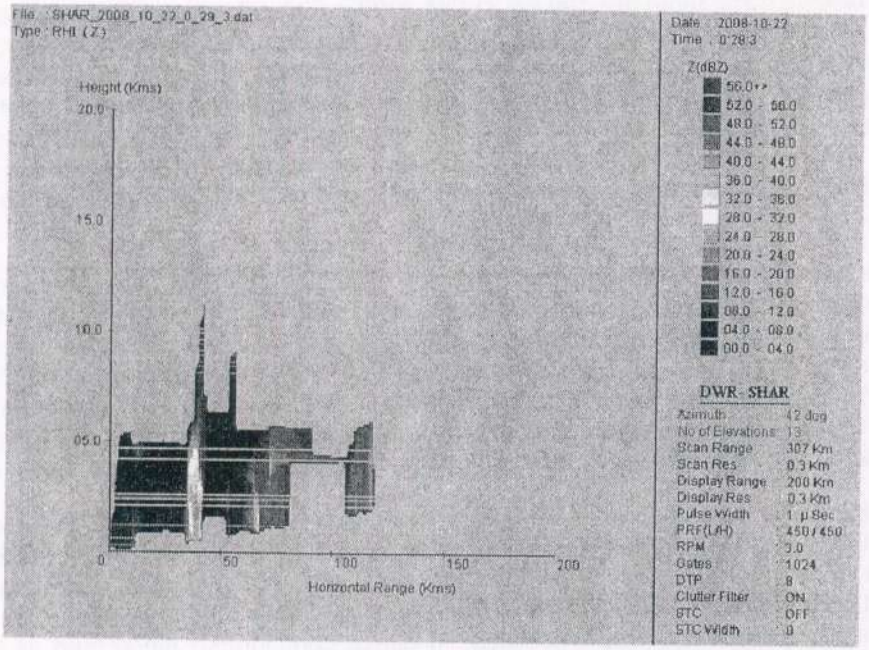
Automatic Weather Station(AWS) installed in the premises of CDR SHAR recorded a rainfall of 33 mm from 03 UTC of 21 Oct 2008 up to 19 UTC(0030 hrs of 22 Oct 2008). There was no rain up to 00 UTC of 22 Oct 2008. Hourly rainfall data indicates that rain occurred after 00(0530 a.m.) UTC and by 01(0630 a.m.) UTC a rainfall of one mm had occurred. By 03 (0830 a.m.) UTC, 5 mm of rainfall had been recorded. It rained continuously since then as is evident from the hourly rainfall pattern shown in the figure. A record rainfall of 109 mm occurred at SHAR up to 23 UTC of 22 Oct 2008.

---

[2] Meteorologist Gr.II, RMC Chennai




*(Radar picture courtesy: Shri.Arul Malar Kannan, Met. I/C CDR Sriharikota)*

I heard from my colleagues that in Mylapore and Mambalam areas too it rained around 0625 a.m., though that spell of rain was not felt in the suburbs of Anna Nagar where I live. I could feel the intensity of the incessant rain only around 0840 a.m. while I was on my way to office. It was literally a blinding rain, Mother Nature dancing with all her glory. It appeared as if a caring mother was blessing the launch of Chandrayaan-1 after being a proud and silent onlooker for a few crucial hours.

ISRO scientists had said earlier that the spacecraft is rain-proof and their only concern was that there should not be any lightning activity at the time of launch. Lo Behold! There was no lightning till the spacecraft roared out into space towards the assigned elliptical orbit. Zeus, the Greek God is known as the sky god who controls lightning, which he uses as a weapon, and

thunder. I was amazed at the divine way of Zeus as he was the invisible star of the day! An untold but evident promise of Zeus; so I perceive and bow in reverence!

One verse of the great Tamil poet Thiruvalluvar reverberated in my mind, at the end of the live telecast of the successful lunar launch mission in the television. He, in his treatise Thirukkural, a masterpiece in Tamil literature which has the highest and purest expressions of human thought has said in Chapter 62-Verse 620, that "Tireless toilers working hard will leave even fate behind". The exact Kural is reproduced below.

ஊழையும் உப்பக்கம் காண்பர் உலைவின்றித்
தாழாது உஞற்று பவர்.

The hard work and commendable contribution of the entire ISRO team, the untiring and unconditional support of their families, employees who spent sleepless nights for this success - all deserve special praise for their commitment and being a proof of the time tested saying "***Where there is a will there is a way" – straight to the moon - and there is NO DREAM TOO BIG!***

*****

# Enjoying the art of exploring the beauty of nature

B.Geetha[3]

Quite often we tend to believe that *Science* and *Arts* are totally different in their objectives and ideas. An artist is generally not expected to understand complex scientific concepts and a scientist is not expected to be appreciative of any art form. While an art thrives on one's imagination and perception of ideas and concepts, science deals with systematic and logical considerations of facts and concepts capable of being verified from time to time.

*Science*, by definition, is the pursuit of "*true knowledge*" or "*truth*" by systematic and logical considerations that are often termed as "*scientific method*". According to Karl Pearson, there is unity in all branches of science in the form of this *scientific method* which is nothing but the method of all logically trained minds. This method attempts to pursue truth by experimentation, observation and logical arguments from accepted postulates. It aims at formulating most general axioms or "*scientific theories*" by using relevant concepts based on empirical evidence. It is committed to *objective considerations* only and presupposes *ethical neutrality*. As such, it is a method free from personal bias or prejudice, proceeding in an orderly manner guided by rules of logical reasoning and internal consistency and finally culminates in a "*result*" capable of being verified. This time tested *result* is therefore an eternal "*truth*". The *art of arriving at the truth*, i.e., the *scientific method* has an intrinsic "*beauty*" capable of being appreciated by all logically trained minds and one is reminded of John Keats' famous metaphysical phrase - "*Beauty is truth and truth beauty*" (Ode on a Grecian Urn).

Indulging in the intricate art of *scientific method* gives immense pleasure and satisfaction to the person concerned and the *result* arrived at gives a value addition to the entire scientific community. However, like any art form, it also has to be performed with great care and precision. Otherwise, faulty assumptions, poorly designed & badly executed experiments and faulty interpretations would lead to wrong results not capable of being verified by facts time and again. As such, like any poorly performed art, it is also likely to be subjected to criticism and rejection.

While pursuit of scientific knowledge itself is an enjoyable *art*, pursuing it in the science of meteorology is even more enjoyable as it deals with unfolding the latent truth underlying the complexities of *Mother Nature* wherein physical concepts, chemical processes and mathematical equations governing atmospheric processes are entwined and are studied either independently or in a unified statistical approach. The results of such studies are useful in social planning and disaster mitigation so much so, that, meteorological service agencies are very much sought after by governments and NGOs. At a time when our country's ace meteorological agency (IMD) is on a modernisation spree and when its top level personnel are already toiling hard to provide the necessary thrust and direction, we humble beginners shall gear up to contribute our bit, in whatever way required. After all, working in the science of meteorology is not a tiresome job but a doubly enjoyable art.

---

[3] Smt. B. Geetha, SA RMC Chennai

# Mapping the Maps

K.V. Balasubramanian[4]

Map of a place helps us to understand the area well. To plan and complete the developmental works and also to plan war strategies maps are very essential. Before going on a tour to a far away place we try to see the maps of the place to know the important areas and roads. Now 'Goggle Earth' facility is available through the Internet so that we can have a three-dimensional look at the place we want to see. The roads and the by-lanes of a city like Chennai are also available in some mobile phones. People understand the details of weather easily through maps. The Meteorologists locate the low pressure areas, depressions and cyclones by analyzing weather details depicted on a map. Hence it will be interesting to know how man created maps and started using it.

The ability of man to draw the things that he has seen is the forerunner for maps. A clay tablet unearthed in 'Assyria' tells us how 'North Mesopotamia 'was in 500 B.C. The early Indian literature gives us good information about various parts of India. The travel of Lord Rama from north India to Sri Lanka, the pilgrimage of Arjuna in 'Mahabharatha', the 'Jambhukanda Nirmana Parva' in Mahabharatha gives us information about the rivers, mountains, cities of various parts of our country which helps us to reconstruct the map of India.

'Panini' ($5^{th}$ – $4^{th}$ century BC) in his grammatical rules refer to peoples and cities demonstrating his knowledge of South Asian geography. The first of book of Tamil is 'Tolkappiam' which is surprisingly a work on Tamil language grammar. A poet by name 'Panambaranar' has written a poem as a preface to Tolkappiam which gives us the extent of the then Tamil Nadu. The poem reads like this

"வடவேங்கடந் தென்குமரி
ஆயிடைத்
தமிழ்கூறும் நல்லுலகத்து"

The borders of the then Tamilagam is also mentioned in two poems 'Puranaanooru', one of the books of eight anthologies. They are

"வடாஅது பனி படு நெடு வரை வடக்கும்,
தெனாஅது உரு கெழு குமரியின் தெற்கும்.
குணாஅது கரை பொரு தொடு கடற் குணக்கும்,
குடாஅது தொன்று முதிர் பௌவத்தின் குடக்கும்" (புறம், 6, 1/4)

"தென் குமரி, வட பெருங்கல்
குண குட கடலா எல்லை" (புறம், 17, 1-2)

## Travelogues and stone inscriptions

The travelogues of the foreign travelers viz. 'Megasthanese', 'Fahien', 'Hieun-Tsang' gave very important geographical information of India of their times. One of the twin epics of Tamil 'Silappathikaram' is practically a book of geography because it describes the kingdoms of the

[4] Assistant Meteorologist, RMC Chennai

three kings 'Chola', 'Pandya' and 'Chera', the three big cities 'Poompuhar', 'Madurai' and 'Vanji' and describes the route traveled by 'Kovalan and his wife Kannagi' from Poompuhar to Madurai. Many scholars have researched on this epic and reconstructed the map of the then Tamilagam.

The inscriptions of 'Devanampriya – Asoka' inform us the status, length and breadth of his empire. The Allahabad inscription of 'Samudra Guptha' gives us the list of nations conquered by him which helps us to reconstruct his empire.

## Raja Todarmal and his land surveys

Land surveying and map making, an integral part of any government, was pioneered in India by Raja Thodarmal who was employed in the military operations in Akbar's empire. In 1567 Thodarmal along with Muzaffar Khan, the Chief Fiscal Officer in Akbar's court effected a major change in the revenue collection procedure. A new procedure for collecting information about the area of land- cultivated and uncultivated, produce of the land and land revenue statistics – was implemented. He divided the empire into twelve provinces, each with a Governor and a Diwan for the survey of land and the collection of land revenue. A re-survey was ordered for every ten years. This information helped the Europeans to prepare the maps of India in latter days.

## Theatrum of Ortelius

In the 17th century, the 'Theatram of Ortelius' was published (by 'Abraham Ortelius' a Belgian by birth, considered as the Father of Modern Atlas). 41 editions of Atlas in Latin, Dutch, German. French, Spanish, Italian and English languages were published. There were successive stages of in the making of new map of France, such as the measurement of an arc of meridian of Paris by 'Abbe Picard' in 1669-70 by means of a chain of triangles and a planned survey of the whole country. Following the establishment of Royal Observatory of Greenwich English maps began to use Greenwich as their prime meridian, a fixed point from which longitude was measured.

## James Rennel

'The Father of Indian Geography', James Rennel, was the Surveyor General of Bengal. He collected the geographical data acquired by British army columns on their campaign and began to map all of India in 1765. He heavily depended upon 'Ain-e-Akbari' which provided him the information about the Mughal Empire. His Bengal Atlas (1781) was the earliest known reference of an Atlas in India.

## The Great Trigonometric Survey of India

After the victory over 'Tippu Sultan', almost the entire peninsula came under the control of East India Company. The then company officials realized that the preparation of maps of the area will be very beneficial in their military operations. Hence they ordered surveys to locate the Hills Rivers etc of the area. Many surveyors of the company were involved in this job and small maps of different areas were prepared. However there was difficulty in migrating from one map to another, since no co-ordinates were available at that time. Around this time in 1799 Col. William Lambton proposed a plan of mathematical and geographical survey right across the sub-continent. In his proposal, Lambton noted – The Surveyors of particular districts will be spared much labour when they known the position of some leading points and which they can refer because when these points are laid down in the exact situation in they are upon the globe, all the other objects will also have their situations true in latitude and longitude-.

## The Regional Met Centre at Nungambakkam

The Great Trigonometric Survey (GTS) commenced on 10th April 1802 from Chennai (the then Madras). Lambton started survey from Madras because there was an Observatory from 1789. It had been doing some astronomical calculations related to stars. The then Government Astronomer, 'Mr. J. Goldingham' has calculated the position of Madras in terms of longitude and

latitude more precisely than any where else in India. It was a kind of bench mark from which all the other measurements would be taken. A reference about this position is still available in the stone pillar maintained as a monument in the premises of Regional Meteorological Centre, No. 6, College Road, Chennai-6. (Fig -1 and Photos 1-6 showing the pictures of the pillar, the inscriptions in Latin, English, Tamil, Telegu, Arabic)

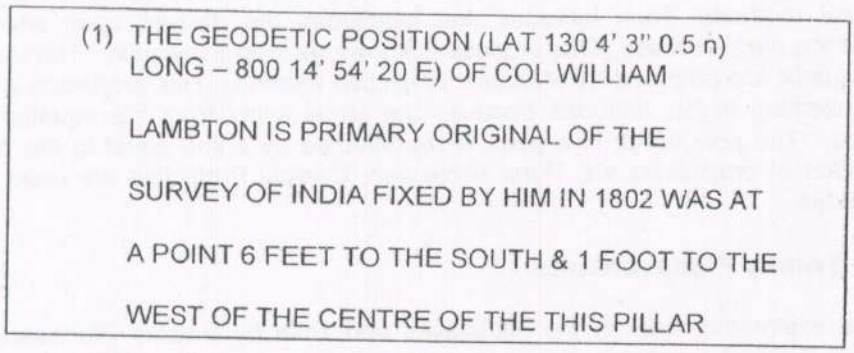



Fig. 1: The English inscription on the Granite pillar

## Lambton and St. Thomas Mount

The Government approval for the GTS was given on 5th February 1800. Lambton did a trial survey in September 1800 near Bangalore. He commenced the trigonometric survey on 10th April 1802 with the measurement of a base line near Madras. The base line was 12.8 kms long on a flat plain, with St. Thomas Mount at its northern end and Chinnamalai at its southern end. From the Madras baseline a series of triangles was carried up to the Mysore plateau and a second baseline was measured near Bangalore in 1804. In 2002 bi-centenary celebrations of this event was held and a statue (bust level) of Lambton was installed in St. Thomas Mount.

## Mt. Everest

Col. Lambton continued this survey through Gooty, Masulipatnam, and Goa and reached Nagpur. He died on June 20, 1823 near Nagpur at a place called 'Hinjughat'. In 1818 George Everest joined Lambton in this Geodetic Survey. Later he was the head of the Survey of India department. The works of Survey of India lead to the identification of the location of the highest peak in the world and it was named as Mt. Everest in recognition of the works of Sir George Everest.

## GTS and the role of Indians

The Great Arc determined by the GTS has always been presented as a British achievement. Lambton and Everest, associated with it, were British, but one has to remember that most of the mathematical work which is really most important aspect of the expedition was done by Indians. One important name to mention is that of Sri Radhanath Sikdar. Radhanath Sikdar had joined the Survey of India at Dehra Dun in December 1831 in the post of Computor and he was the first Indian to do so. He was barely nineteen years old at that time. Dr Tytler, Professor of Mathematics at Hindu College, Calcutta, had recommended his pupil's name to George Everest for his keen mathematical proficiency and investigative mind. Both George Everest and his successor, Andrew Waugh had held Radhanath in high esteem, and Everest had this to say about him, "There are few in India, whether European or native, that can at all compete with him. Even in Europe these mathematical attainments would rank very high." (Courtesy: Breeze 1 2007). Precision engineering necessary for the instruments to the GTS is very critical. A lot of these instruments were made in India. The expedition's senior instrument designer and engineer were in fact from Arcot in Tamil Nadu. He was called 'Syed Hussien Mohishin'. He was

a brilliant instrument manufacturer. Lambton and Everest were heavily indebted to him. Also in the field the contribution of Indian labourers is very vital.

## Map Projections

Maps are drawn on a flat surface and represent a part or whole of the earth surface. The spherical shape of the earth is represented on the plane surface by devising geometrical and mathematical methods. Then latitudes and longitudes are derived upon which an accurate depiction of the earth is made. This process is known as Map Projection. The maps for the area near the equator are prepared by Mercator projection method. This projection is not suitable for areas representing higher latitudes because the areas away from the equator are very much exaggerated. The pole which is a point is represented by a line equal to the equator. Hence other methods of projections viz. Polar Projection, Conical Projection are used in representing higher latitudes.

## Works of Swamy Pranavananda

The exploration work in the Himalayas and Tibet by Swamy Pranavananda, a Telugu sanyasi was a commendable one. He explored the areas of Holy Kailash and Manasarovar unfolding the mystery and beauty of Himalayas. He discovered the true sources of four great rivers viz. the Indus, the Sutlej, the Brahmaputra and the Karnali. The Royal Geographical Society of London and the Survey of India accepted his findings. The Survey of India has incorporated them in the maps published since 1941. His thrilling book "On Exploration of Tibet" was published by the University of Calcutta in 1950.

## Present Status

Land survey is still in use in preparation of highly informative maps. However with the arrival of satellite technology and high speed computing the science of preparation of maps has got a great boost. Satellites give information from uninhabited areas through their visual and infra-red imageries. Computers provide the facility to view the maps as per our requirement. The arrival of GPS has made it easy to get latitude, longitude, height above mean sea level and time of a place within seconds. The same technique is also available in some of the modern mobile phones.

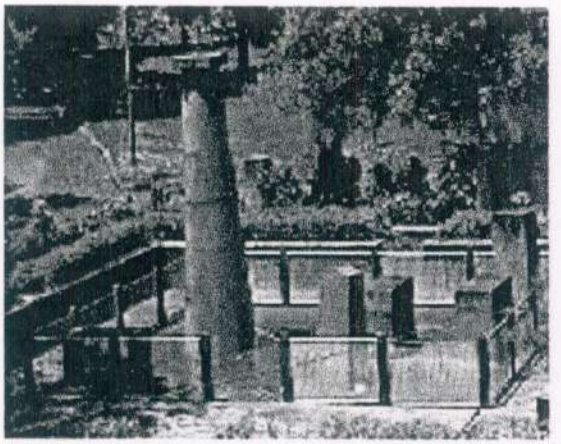



Photo 1 & 2:The monuments maintained by the Regional Meteorological Centre and the notice board

Photo 3: The inscription in Urdu on the granite pillar.

Photo 4: The inscription in English on the granite pillar.

Photo 5: The inscription in Telugu on the granite pillar.

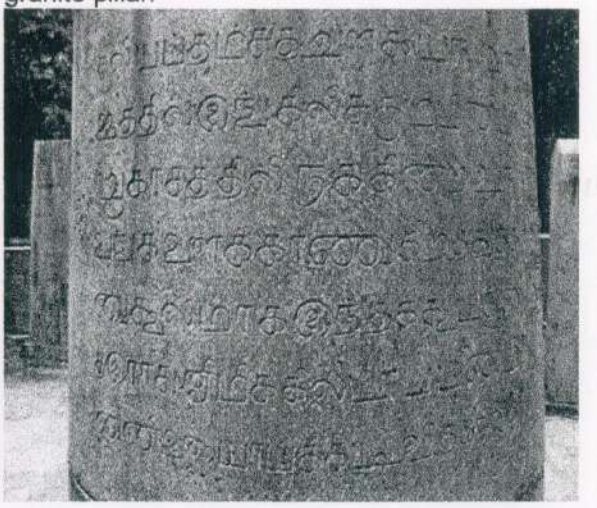


Photo 6: The inscription in Tamil on the granite pillar.

# Midget Cyclonic Storm "OGNI" – 2006

R.Nallaswamy[5]

Brief history of the system:

(a) A low pressure area formed over southwest Bay of Bengal off Tamil Nadu coast on 28th October 2006.

(b) Intensified into a Depression and lay centered near lat. 14.0°N and long. 80.5°E at 0000 UTC of 29th. While moving slowly in a northerly direction, it intensified into a deep depression and lay centered near lat. 15.0°N and long. 80.5°E, about 50 km east of Kavali at 0900 UTC of the same day.

(c) Remaining practically stationary, the system further intensified into a Cyclonic storm at 1200 UTC of 29th. Till 0300 UTC of 30th, the system moved very slowly in the northerly direction. It lay centered near lat. 15.5°N and long. 80.5°E, about 30 km east of Kavali at 0000 UTC of 30th October 2006.

(d) The cyclonic storm weakened into a deep depression at 0600 UTC of 30th. It crossed Andhra Pradesh coast between Bapatla and Ongole as a deep depression around 0700 UTC of 30th October, 2006.

(e) After crossing the coast, the system weakened into a depression at 0900 UTC of same day.

(f) The depression further weakened into a low pressure area over North Andhrapradesh and adjoining areas at 1200 UTC of 30th October, 2006.

(g) Maximum T.No.2.5 was assigned from 1200 UTC of 29th to 0300 UTC of 30th.

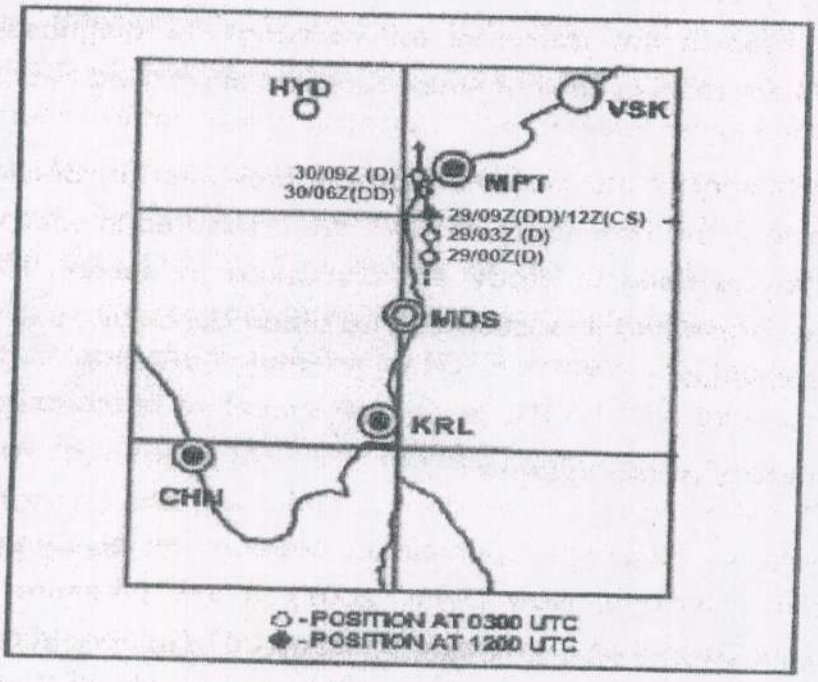



Fig. 1 Track of cyclonic storm during 29-30 October 2006.

[5] Assistant Meteorologist, RMC Chennai

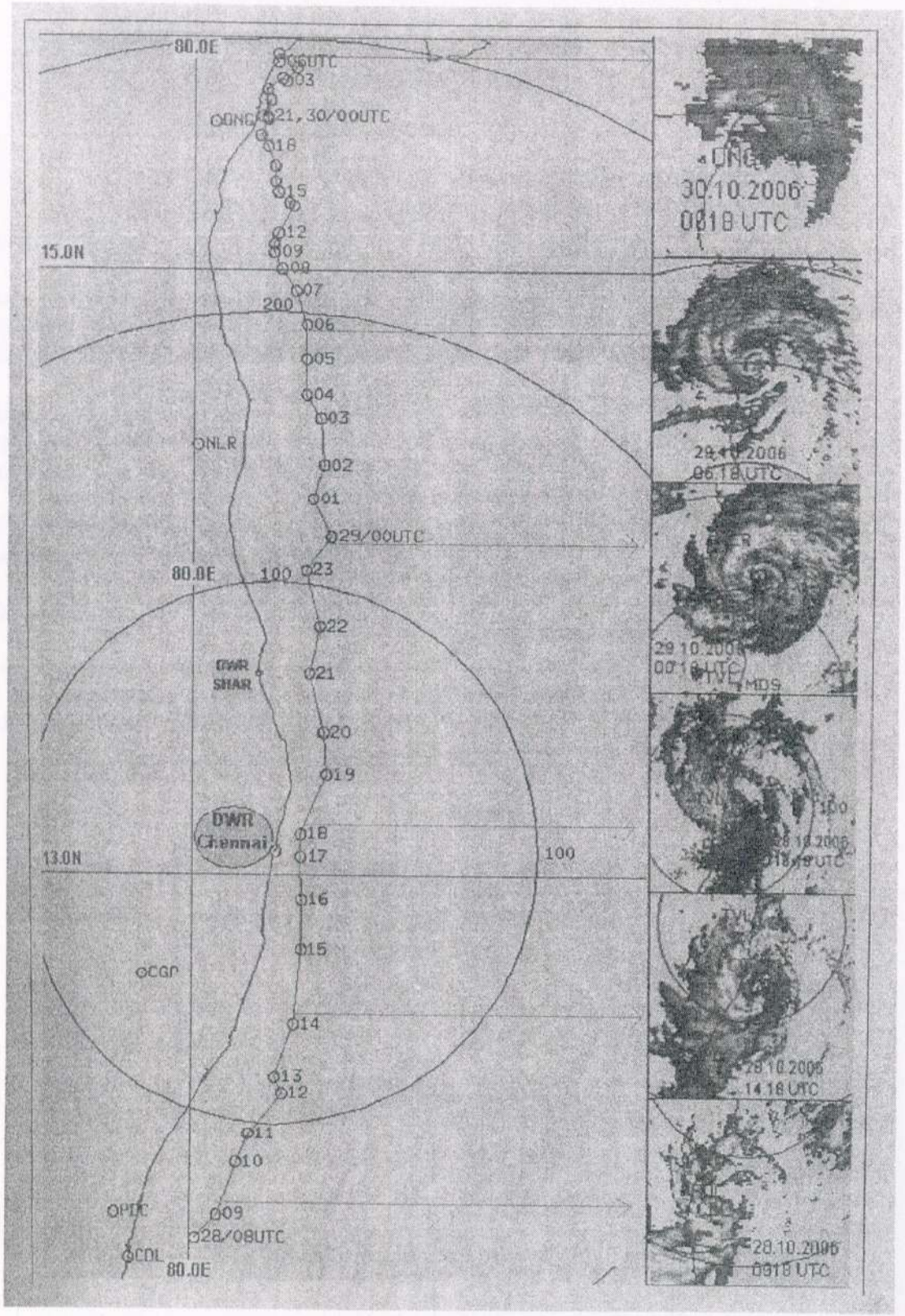



Fig. 2 Radar images along with track of cyclonic storm 'OGNI' during 29-30 October 2006.

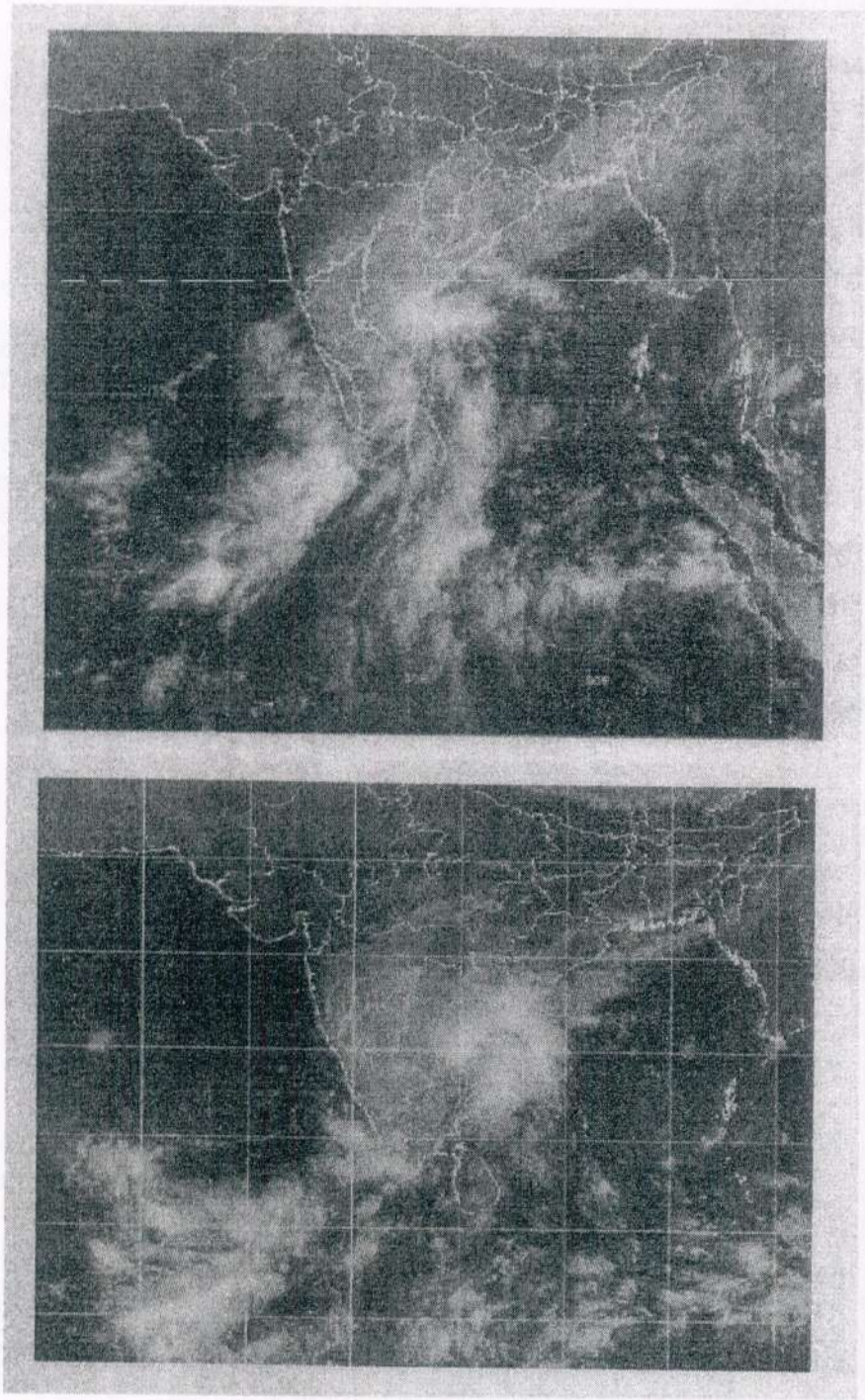


Fig.3 Satellite Kalpana-1 imageries at 0600 UTC of 28th
And 0600 UTC of 29th October 2006.

**Rainfall and Damage :**

There was no significant damage due to strong winds and storm surge, as the storm weakened over the sea itself and crossed as a Deep Depression. However, the system caused flash floods due to the heavy to extremely heavy rainfall over Coastal Andhrapradesh during October 29-31, 2006 resulting in loss of life and property.

The amounts of heavy rainfall(≥ 7 cm) over Andhrapradesh are given below:

**29.10.06** : Ongole-19, Kakinada, Amalapuram and Kandukar-13 each, Avanigadda-10, Sullurpet-9, Kavali and Repalle-8 each, Nellore and Gudur-7 each.

**30.10.06** : Avanigadda-35, Repalle-28, Machilipattinam –27, Bapatla-20, Amalapuram-16, Narsapur and Kakinada-15 each, Bhimavaram, Gudivada and Tenali-12 each, Tanuku-11, Guntur, Kaikalur and Gannavaram-10 each, Koderu and Mangalagiri-9 each, Ongole, Kandukur and Peddapuram-8 each, Visakahapatnam, Addanki, Eluru and Rajahmundry-7 each.

**31.10.06** : Gudivada-55, Machilipatnam-34, Avanigadda-32, Narsapur-22, Gannavaram-19, Kaikalur-16, Amalapuram and Eluru-15 each, Bhimavaram-14, Mangalagiri-13, Bapatla-12, Chintalapudi and Koderu-11 each, Tanuku-10, Prakasam Barrage-9, Bhimadole and Nuzvid-8 each, Tadepalligudem and Kakinada - 7 each.

Maximum estimated wind speed was 35 Knots.

The following damages were reported in Andhra Pradesh (as per the IMD publication).

| | |
|---|---|
| Loss of life | : 24 |
| Livestock | : 3,61,553 |
| Loss of crops | : 1,99,986 acres |
| Villages submerged | : 900 |
| Damage to houses (fully) | : 26,853 |
| Damage to houses (partly) | : 73,218 |

The cyclonic storm "OGNI" had the following unique features.

i) Small core (~100 km)
ii) Shorter life period (~18 hours)
iii) Nearly northerly movement over the sea close to the coast.
iv) Slower than normal movement.
v) Weakening of the system into a deep depression over the sea itself before landfall.
vi) Extremely heavy rainfall due to the system leading to flood.
vii) The system was mainly detected and tracked by Doppler Weather Radar (DWR) at Chennai, Sriharikota and Machilipatnam.

The Ogni cyclone was a small core and short lived one. It could be detected by Doppler weather Radars and coastal hourly observations. Its exact intensity could not be estimated using Dvorak's technique. Considering these facts the cyclonic storm Ogni may be called as a midget (very small) cyclone similar to the midget cyclones developing over the northwest Pacific Ocean and South China Sea and a few in the North Indian Ocean .

**********

# Conservation of Angular Momentum and its application

R. Samuel Selvaraj[6]

Angular momentum of a particle about a given origin is defined as product of the mass (m), the velocity (v) and the radial distance (r)from the origin.

Thus angular momentum = mvr

As long as there are no external twisting forces (torques) acting on the rotating system, the angular momentum of the system does not change. We say that the angular momentum is conserved; i.e. the product of the quantity **mvr** remains constant. This implies that a decrease in radius must produce an increase in speed and vice versa. An ice skater, for instance, with arms fully extended rotates quite slowly. As the arms are drawn in close to body, the radius of the circular path decreases which causes an increase in rotational velocity (v), and the skater spins faster. As arms become fully extended again, the skater's a speed decreases. The conversation of angular momentum when applied to moving air will help us to understand the formation of a jet stream.

## Formation of Jet Streams

Consider heated air parcels rising from the equator on a clam day. As the parcels approach the tropopause they spread laterally and begin to move pole ward. If we follow the air that is moving northward we see that, because of the curvature of the earth, air constantly moves closer to its axis of rotation (r decreases). Since angular momentum is conserved (and also since the mass of air is unchanged), the decrease in radius must be compensated by an increase in speed. The air must, therefore, move faster at the east than a point on the earth's surface does. To an observer, this is a west wind. Hence the conservation of angular momentum of northward flowing air leads to the generation of strong westerly winds and the formation of a jet stream.

## Explanation of Hadley Circulation and jet streams

To illustrate the application of this principle of the conservation of angular momentum by the atmosphere, let us put some figurers in to the formula and investigate the behavior of the Hadley circulation of the tropics. If it is assumed that the air rises at the equator in the Hadley circulation (for the sake of simplicity) let us assume that it is stationary with respect to the surface there (i.e. v=0), its absolute motion about the earth's axis will be a speed vö (here $v_0$) of 1.676 $kmh^{-1}$ = 465 m/sec (the speed of the earth's surface from west to east in space). As the air moves pole wards aloft, its distance from the earth's axis decreases when it reaches latitude $30^0$ (the vicinity of the easterly sub-tropical jet stream aloft) this distance will be 0.866 of its original value (as rcos 30 = 0.866r). To maintain the constancy of its angular momentum, its 'velocity x radius of curvature per unit mass' must remain constant, so its absolute velocity must increase to 1,935 $kmh^{-1}$ (i.e 1,676 x 1/0.866) to compensate for the reduction is radius. The speed of the 'earth's surface at latitude $30^0$, however, is only 1,451 $kmh^{-1}$ (i.e reduced by the same proportion as the radius). Thus if the absolute angular momentum is to be conserved, the air would be moving west to east relative to the earth's surface at a speed of 484 $kmh^{-1}$ (or 1,935 – 1,451 $kmh^{-1}$) or some 268 knots. This overestimates the velocity of the westerly subtropical jet stream, as it does not incorporate the effects of internal turbulence and friction. The conservation of absolute angular momentum argument is the main theoretical explanation of the high level subtropical jet stream at the pole ward limit of the Hadley circulation.

## The second application – Slow movement of Earth

As the motion of the earth around the sun is under gravitational force which is a central force, the angular momentum of the earth moving round the sun is conserved. When the earth is at the perihelion i.e. closest to the sun, the angular velocity is maximum and when the earth is at

---

[6] Dr. R. Samuel Selvaraj, Department of Physics, Presidency College, Chennai

the aphelion i.e. farthest way from the sun it angular velocity is minimum. Let us explain this with an illustration.

As the motion of the earth round the sun is under gravitational force which is central force, the angular momentum of the earth act the two positions the perihelion and aphelion is conserved.

(or) Angular momentum at aphelion = angular momentum at perihelion

$$mv_{ap}\, r_{ap} = mv_{peri}\, r_{peri} \text{ ------ (1)}$$

The earth is moving round the sun under gravitational force and its orbit has semi-major axis $1.495 \times 10^8$ km. When the earth at its perihelion, it is closest to the sun and its distance from the sun is $1.47 \times 10^8$ km and its orbital velocity is 0.303 $kms^{-1}$.

now $r_{peri} = 1.47 \times 10^8$ km

Semi major axis $a = 1.495 \times 10^8$ km therefore Major axis $= 2a = 2.990 \times 10^8$ km

Now $r\, r_{rap} = 2a.r\, r_{peri} = 2.990 \times 10^8 - 1.47 \times 10^8 = 1.520 \times 10^8$ km

Substituting in (1) we have $v_{ap} \times 1.52 \times 10^8 = 0.303 \times 1.47 \times 10^8$

Therefore velocity of the earth at aphelion

$v_{ap} = 0.303 \times 1.47 \times 10^8 / 1.52 \times 10^8$

$= 0.293$ $kms^{-1}$

The angular velocity at the perihelion $\dot{u}_{peri} = V_{peri} / r_{peri}$

$= 0.303 / 1.47 \times 10^8 = 0.206 \times 10^{-8}$ rad $s^{-1}$

The angular velocity at the apehilion $\dot{u}_{ap} = v_{ap} / r_{ap}$

$= 0.293 / 1.520 \times 10^8 = 0.193 \times 10^{-8}$ rad $s^{-1}$

From the above it may be clearly seen that the earth travels slowly when it is farther from the sun and it takes the earth a little more than 7 days longer to travel from March 20 to Sep 22 than from Sep 22 to March 20.

## The third application – explanation for El-Nino phenomenon

The sum of the angular momentum of the solid earth and that of the atmospheric system must remain constant unless an outside force or torque is applied. Thus, if the atmosphere speeds up due to say stronger westerly winds, the earth may slow down and thereby the length of day may increase.

The change in wind direction and speed makes the atmosphere act as a huge blanket trying to obstruct the rotation of the Earth. Since the atmosphere act as a drag it manages to reduce the speed of rotation. At the same time the energy of the movement is converted into heat and released into the atmosphere adding the El-Nino Effect. Therefore the breaking action serves two purposes, it increases temperature and it slow down rotation. But this does not last forever.

John Cipson a Scientist from the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Centre said that the energy going from the Earth into the atmosphere is causing it to slow down. According to NASA estimates by July 1997, El-Nino had slowed down the Earth's rotation by 800 microseconds. Through out the El-Nino phenomenon, which was expected to taper off in August 1998, the Earth's rotation has slowed by an average of 300 to 400 ms.

## References:

1. Down to Earth, July 15, 1998 (Marking time)
2.Classical Mechanics K.Sankar Rao, (Princtice – Hall of India)

## Activities of IMS Chennai Chapter since the last issue of Breeze.

1. 40 members from IMS visited the SDSC SHAR Centre, Sriharikota on 04.06.08 and interacted with Scientists and Engineers and learnt about the facilities and techniques at SHAR.
2. 30 members visited SERC under CSIR Chennai on 17.10.08 and saw the labs, facilities and activities.
3. Dr. H. Annamalai of Hawaii University, USA delivered a talk on "Response of Monsoon through Global Warming" on 28.07.08.
4. Local Council Meeting and AGB Meeting were held on 18.07.08.
5. 4 new members were added.

**Forthcoming events**

1. A study visit to IGCAR, Kalpakkam is planned on 20th February 2009.
2. National Science Day will be celebrated on 27th February 2009 with special lectures on the performance of monsoons 2008.
3. WMO Day will be celebrated on 23rd March 2009 at RMC Chennai with special lectures and exhibition.

******

# INDIAN METEOROLOGICAL SOCIETY, CHENNAI CHAPTER

E-mail ID: ims.chennai6@gmail.com

## COUNCIL MEMBERS 2007-09

S/Sri/Smt/Dr.

Chairman — Dr.Y.E.A. Raj
Ph.No.044-28277652
E-mail Id : yearaj@gmail.com

**Secretary** — Shri R.Nallaswamy
Ph.No.044-28230091 Ext.251
E-mail Id : rns115@gmail.com
Mobile: 9444713976

**Joint Secretary** — Shri.S.Balachandran
Ph.No.044-28230091 Ext.252
E-mail Id : balaimd@gmail.com

**Treasurer** — *Shri.K.V.Balasubramanian*
Ph.No.044-28230091 Ext.245
E-mail Id : kvbmanain@yahoo.com
Mobile: 9884715004

## Members

| | |
|---|---|
| Shri S.Raghavan<br>Ph.No.044-24522228<br>E-mail Id : manmatha@dataone.in | Shri.P. S.Kannan<br>Ph.No.044-28230091 Ext.256<br>E-mail Id : kannan_imd@yahoo.com |
| Dr.R.Suresh<br>Ph.No.044-22561636<br>E-mail Id :suresh.imd@gmail.com | Smt B.Geetha<br>Ph.No.044-28230091 Ext.205<br>E-mail Id : bgeetha67@rediffmail.com |
| Shri. S.R.Ramanan<br>Ph.No.044-28229860<br>E-mail Id : sr.ramanan@yahoo.com | Dr.T.N.Balasubramanian<br><br>Mobile.No.9894124228<br>E-mail Id : ramsankar27@sify.com |
| Dr.A.Muthuchami<br>Ph.No.044-28230091 Ext.201<br>E-mail Id : vamcmi203@gmail.com | Dr.G.Latha<br>Ph.No.044-66783399<br>E-mail Id : latha@niot.res.in |
| Dr. S. Rajarathnam<br>Ph. No. 044-22301558<br>E-mail ID:<br>dr_rajarathnam@yahoo.com | Dr. S. Gomathinayagam<br>Ph. No. 044-22541605<br>goms@sercm.org |