Indian Society of Remote Sensing
Ahmedabad Chapter

NEWS LETTER

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Dear Members,

Back in 1976 I vividly recall my predicament when I was to appear at Space Applications Centre for the interview of a post related to 'remote sensing'. Neither I nor any one of my colleagues knew what exactly this 'remote sensing' was. Since then a sea change has taken place. Today an average well informed Indian probably has at least a faint idea of remote sensing. It indeed is a great transformation. But how has this happened? Through this issue of Newsletter we bring you a peep in the history of remote sensing in the country. Our theme is to concentrate on 'who' has played a pioneering role instead of a giving a chronnology of 'what' events took place. So we have here flash back of history as captured through the eyes of Prof. P R Pisharoty whose pioneering endeavours have immensely enriched this branch of knowledge and led directly to the present bloom.

It is our privilege to dedicate this issue of Newsletter to Prof. Pisharoty who is fondly called 'Father of Remote Sensing in India'. He was kind enough to talk to Newsletter about not only past but also the present and future of remote sensing and meteorology in India. He also has some tips for success in life for scientists along with philosophical aspects of life and work and implicit recommendation of 'Guru-Shishya' tradition. We proudly reproduce his views in the opening pages.

A bit of nostaliga is sometimes refreshing and can be illuminating too - particularly when it is reminiscences of Dr. T A Hariharan who retired in February 1989 as Chief Scientist, Remote Sensing Area. Dr. Hariharan has been associated with remote sensing since early days and has pioneered the sensor development activities and headed Meteorology Division for a long time. We are sure that his reminiscences will make an interesting reading.

And lastly we will once more request you to share your feelings with us on various articles or issue of Newsletter as a whole. We will also welcome your contributions under the heads of views, opinions, research notes, suggestions, or glimpses of personal achievement etc. apart from regular columns. So please communicate.

We would like to acknowledge the cooperation from Shri V Tamilarasan former Editor of ISRS Newsletter in conducting this interview and Dr. M B Potdar in framing the questionnaire for the interview.

- Editor

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INTERVIEW

Prof. P R Pisharoty, Professor Emeritus, Physical Research Laboratory, Ahmedabad is a meteorologist of world eminence and is a recipient of International Meteorological Organisation Prize 1989 awarded by World Meteorological Organisation. He has also made pioneering contributions towards the emergence of remote sensing in this country, due to which he is fondly called 'The Father of Remote Sensing'. Born in February 1909 in Kerala, Prof. Pisharoty was a research student with Sir C V Raman. He later obtained his Ph. D. from University of California at Los Angeles (UCLA). He has been closely associated with various national and international meteorological projects. On his suggestion, Government of India has procured a supercomputer for medium range weather forecasting. In the field of remote sensing, Prof. Pisharoty was instrumental in carrying out the first experiment in the country and helped in propagation of this budding technology for various applications. He also headed Remote Sensing and Meteorology Division of Space Applications Centre at Ahmedabad. Prof. Pisharoty has authored about 100 research papers and 50 popular science articles. His recent publications are 'Meteorology for Indian Farmers' and 'The Satellite Story'. A recipient of Padamshri award in 1970, Prof. Pisharoty is currently Vice President of India Meteorological Society. As a mark of respect and gratefulness Indian Society of Remote Sensing recently felicitated Prof. Pisharoty on his 80th birth day.

The grand old man granted us this interview with a smile. We met him in his PRL Office where he continues to lead an active life with no visible dent of years gone by. He spoke in his characteristic inimitable style of presentation with humourous touch, ample gesticulation and forceful, demystifying logic - the qualities which have endeared him to so many spell - bound audiences.

Throughout the one-and-half hour length of the interview, we listened him with rapt attention of mesmerised kids listening to grandpa's old stories. Thanks to our dispassionate tape recorder, we reproduce here the interview - an essence of 30 years' history of remote sensing and the life and letters of a visionary. Much of this reproduction was painstakingly pruned by Prof. Pisharoty himself.

Q. Could you tell us how remote sensing technology was introduced in India?

A. It began with a very small observation when the Indian Ocean Experiment was done - we had a revelation in 1963-64 that the ocean surface temperature of the Arabian Sea off Bombay was about 30°C - sometimes higher than land temperature during the monsoon. This was subjected to a lot of doubt. I always believe that an observation is correct. There is a tendency amongst scientists to have an hypothesis and not accept anything that is not in confirmation with that hypothesis. That is wrong. So, we had the feeling that the monsoon had got a large dependance on the sea surface temperature (SST), particularly off the west coast of India. When I came to PRL, in 1966 after retirement, this was uppermost in my mind and Prof. Sarabhai asked as to what could be done in Monsoon studies. I said that the sea surface temperature has to be measured and it is not possible to make it using thermometers in ships. This has to be done using an aircraft making use of infrared (IR) techniques. **That was the beginning.**

Prof. Sarabhai said that's fine. Let us do it. I told him that the equipment for this will be costly and we have to develop it and it may cost $ 25,000. Please bear in mind that the total budget for space activities was less than a crore of rupees. He agreed readily and said if 8% returns can be promised for the investment then crores can be invested. He found that a French Laboratory was taking an IR scanner for measuring SST from aircraft. He had contacts with those people and suggested that we make a similar one by doing a collaborative development effort based on the same lines. The technique was to duplicate the efforts on the scanner and have one ready for ourselves and so that a duplicate is being developed along with the original. Dr. T A Hariharan and one more Engineer were recruited and sent to Paris. They developed the scanner and brought it to India. This was all in 1971.

Q. That is all about the first technical development. How did the idea of land applications originate?

A. It was around the same time (1968) that there was an UN Conference on "Peaceful Uses of Outer Space" in Vienna of which Prof. Sarabhai was the Scientific Chairman. In that conference there were 2 papers on Remote Sensing. That was mainly connected with aerial photographs of vegetative cover and to discriminate soldiers in green khakhi uniform moving about in the Vietnam **green forests. The IR reflectance of the** vegetation is different from the IR reflectance of green Khakhi. Both are visibly green but the IR reflectances differ and thus are registered differently in IR photograph. The green khakhi has low reflectance and vegetation a high reflectance.

These two - IR for SST and IR for vegetation were found to be of use and we found that this could be applied in our country also.

Originally, the photographs were for camouflage

detection but later became a part of remote sensing (RS) of vegetation and other land features like water bodies, buildings etc.

After hearing the 2 papers, Prof. Sarabhai asked me to take it up for introducing it in our country. At that time the US was not much ahead of us in RS applications - but only in technology. They had also started experimentation in a small way. They knew that vegetation came up as red and water as blue and so on. Incidently, that's why it is called False Colour IR film. Originally it was called **Camouflage detection film. For a long time it** was classified and when we started on a project here we could buy only limited quantity and not in bulk as was required for the project. For that the President's sanction was necessary in those days.

Q. How was the problem of trained manpower and government funding handled?

A. As we wanted to introduce this in India we thought that a large number of people must be exposed to it. For a subsequent conference on RS, at Ann Arbor, Michigan we wanted a large delegation to attend and learn the various aspects. Dr. Sarabhai had this vision that one man cannot absorb everything and nor will those people be impressed about our commitment to RS. If about 5-6 people were sent, they would feel that we were serious. So we collected a group. Shri Kale was there, one Mr. Subramanyan (alas! he is no more) of Atomic Minerals Survey Department was there. The GSI said that they were not interested. The agriculture department was also not enthusiastic, however Dr. M S Swaminathan said that if all expenses were met by us, he would spare one person. So that's how Dr. Dakshinamurthy came in. We all went there and saw the things in US - at different centres for various disciplines - agriculture, forestry, micrometeorology etc. After attending the Conference at Ann Arbor, we came back with the state-of-the art in RS as it existed in US then.

The people working on RS at Ahmedabad were nil. Only two engineers were there for the scanner. It was felt that the Government must be convinced about the usefulness of the RS activities. RS was a new technology and people had to be convinced. People said RS is not something new but it is just Astronomy. Prof. Sarabhai decided to meet the PM - outside office hours, after dinner at her residence. So we went with a set of colour slides on RS and 2 projectors - so that if one fails the other can be used (redundancy even there). There were 4 or 5 people for the meeting; Dr. Sarabhai, Prof. Ramanathan and myself were there to make the presentation on the application of Remote Sensing in Agirculture, Oceanography, Geology etc. The Cabinet Secretary, Dr. M S Swaminathan and Shri Haksar were also there.

After our presentation, we came back. Prime Minister just heard us and said nothing. I asked Prof. Sarabhai about it, he remarked: "that doesn't matter, PM didn't object and that means she approves".

Q. Could you tell us something about the first RS experiment in India and subsequent developments?

A. After the presentation at PM's residence Prof. Swaminathan told me about the coconut wilt disease in Kerala. He asked if RS technology could be used for detecting the disease early. I rallied that perhaps we could. That is how the first experiment on **Coconut Wilt-Root Disease employing remote sensing technology was started.**

We had no equipment. We wrote to the US (NASA) requesting for the help of a scientist who would come to India with a set of cameras and false colour films for this experiment. We required an aircraft also and there was a helicopter supplied by USSR for use by Thumba Rocket Launching Station. For the project, the Kayamkulam Coconut Research station was chosen as it had coconut plantations and was near Thumba. It was under IARI and they were also asked to collaborate. The Chief Scientist of the Research Station also came into the project and so we had a team of scientists and a team of people to take the photographs. My job was only to collect all these people together. For navigation, we resorted to setting up small fires in the fields. They served as control points. These 'ground-places' were in a pattern (single, square etc.), so as to be easily identifiable.

We had the remote sensing survey carried out and we saw that some of the crowns looked different and the difference was because of the disease. Those crowns appeared 'less red' than the ones that were unaffected. The juice of the leaves of 'less red' trees were taken and were examined under an electron microscope by IARI and the virus was seen in them. So before the farmers could see the appearance of the disease on the tree this methodology could be used for detecting the wilt root disease. However, this technique could not give any cure - but that was not our job, we were only to detect it and we detected it. Our experiment was a great success thus an 'acceptance' was found for RS.

Prof. Sarabhai had other ideas regarding 'acceptance' of the technology. He invited a large number of Parliamentarians, Heads of department in New Delhi, for a lecture on RS. I was asked to give a lecture about the RS technology to them. He had invited them personally (about 200 invitations - but only 100 turned up). The lecture was in the Constitution House, New Delhi. In a sense the audience was impressed. Prof. Sarabhai knew that an acceptance by those people was desirable for the success of the application of remote sensing in India.

So **that was the beginning and was a mark for us to take off.**

Soon after that we had the False Colour IR films

imported in small quantity. And we planned experiments for Agriculture in Karjat. Dr. Madhavan Unni was there and we had aerial surveys. Films were obtained through our friends in USA. It was not ISRO who was buying it. We saw the onion plantations, rice fields, the wheat fields, sorghum fields etc. all looking different.

There were other problems also. Every time an aerial picture was taken the Ministry of Defence wanted to know what we had taken. They had to see the pictures and clear them before scientists could study the pictures.

The next was the project "ARISE" in Anantpur. Dr. Baldev Sahai was the Project Leader. That was the time when there was levy on rice. So the farmers had reported less area under rice. But the photographs showed the reality. Thus, the RS technique was more 'accepted' and people realised that they cannot "bluff" as that would be called off.

Soon after that Dr. M S Dhanju was the Project Leader for carrying out a similar experiment in Patiala and there was no problem at all. People had realised the efficacy of this technique and had reported correctly. By the mere fact that this sort of inventory is possible, benefits accrued immediately.

The technology got accepted generally and rapid developments took place thereafter. Even at the start, Prof. Sarabhai envisaged that ISRO should not be the **end user.** The Secretaries of all user departments were informed about this tool and told that they should decide how best to use this technique. The NNRMS concept is an expansion of that idea.

Around that period, UK was putting up a satellite. They offered space for a 40 kg payload for RS. They were told that Prof. U R Rao would use the 40 Kg payload for his experiments and that a 40 kg payload for RS was not sufficient. We would wait till we get a capability to put a sufficiently large payload (about 1000 Kg). An inadequate use might act as a negative factor in getting satellite remote sensing accepted in the country.

So we had to wait till 1988 for this. But the waiting was worth it. So this is the part of my story.

Q. You had certain perceptions earlier about the future of RS in India. Does it match with what it is now?

A. What we are now is almost 80% of what we had perceived earlier. I feel that our animal population can also be detected by RS. We have crops, water etc. but what about our animal population? I wish that we have a programme where the total number of animals - cattle, wild life etc. can be enumerated, e.g. elephants. There is a lot of poaching - killing elephants for the ivory. One animal means about Rs. 20,000/-. Elephants are ideal "black-bodies". The present resolution in satellite imagery may not be adequate to detect these huge "black-bodies". RS can be from aircraft, helicopter etc. Further, elephants move in herds and so it should be possible.

The forest area has been mapped but not the volume of wood in a forest. You can cut down trees and map the degradation but what about the volume of wood. This could be done from aerial photos. Such information is hardly available. We should do something on this line.

Another area is in the villages. Presently, there are land ownership records and these change so much that the records are not updated so as to include the changes. Based on aerial photographs these could be well-maintained for every village. Even the satellite photographs over Delhi are fairly revealing. It is possible to launch smaller satellite at lower altitudes which provide better resolution. The moment we have our own satellite launching capability we can have this kind of satellites for close observations. That would be helpful in accurate mapping of land boundaries and in checking unlawful violations.

Q. Since 1970 we have thermal scanner. That has not really been used for earth resources. Even Landsat TM has thermal channels but these have not been effectively used. What do you think are the reasons for that?

A. Remote sensing is a developing field; apparently scanning the sea for SST with an IR scanner on aircraft has been superseded. Now we have new sensors; new satellites which provide the information. The exercise of building airborne thermal scanner boosted our morale and gave us confidence in ourselves. Although at that time it was a copy cat business but it was worth it in term of confidence building.

Other day at Haryana, I had shown a picture from SPOT satellite of Dehradun and IRS picture on same film. It was difficult to distinguish between the two. We may be patting our back but it is a deserved patting.

Q. Don't you think that one of the reasons why IR has not been used is because we are trying to get quantitative information from RS. Compared to qualitative applications like mapping, monitoring etc., most of the problem areas in RS relate to the aspects where quantitative information like SST, yield, acreage etc. is derived from RS.

A. This is basically because users were primarily not interested in quantitative information to the extent they ought to have been. Like ancient medical practice, somebody has temperature and that was enough. Now they say 102° F and don't concern themselves with 102.28°. So it is the flaw of the way science has developed. Remote Sensing has a close analogy here. So most of information derived

was qualitative which was reasonably good. But IR comes in the range of quantitative realm. It could have effectively been used for night surveillance. But now it has been superseded by multispectral data. Even now IRS is not operating during night as it does not have IR. Surveying during night has certain advantages. There are some areas where mercury is found and those surfaces will have higher temperature due to mercury vaporisation and diffusion. Here IR scanner will be more useful than satellite. For a mineral prospector this is quantitative information. Such temperature anamolies are of interest to GSI and the demonstration of this may lead to requirement of IR scanner. Accurate measurement of temperature over land surface has many other applications. For example in location of hot springs. This may have medical values and consequent business prospect - in form of selling 'Vichy' water, the kind of beneficially polluted 'Sulphur' water.

Q. How has the satellite meteorology evolved and what is the history of this discipline?

A. The observations for meteorology are taken from inhabited areas of the globe. But such areas are limited as there are deserts, polar regions, oceans, snow covered areas etc. for which data are not available. Data from these areas are also required for weather forecasting even one or two days ahead. Collection of data from uninhibited areas has been possible with the help of satellites. We would like to have more data than the satellite collects. Basically radiation measurement from earth's surface have been made use of for meteorological parameters like cloud top temperatures and cloud cover. Vertical temperature profile measurements came later. Now we are talking about humidity profiles. Now we have a lot more satellite data as compared to 1960s and the whole globe is covered by geostationary satellites. Our own geostationary satellite at present does not provide all the measurements, other satellites do. In future we will have all the capabilities.

Q. How is this satellite meteorology and super-computer fitting into the overall weather forecasting scenario in the country?

A. Since 1875 IMD has been forecasting weather with the help of synoptic weather charts which depict at an instant of time the prevailing meteorological conditions like winds, pressure, temperature, clouds, rainfall etc. in different parts of India. If a cyclone is out in the sea we could not know its location precisely till satellite pictures came in. If there is a rainfall pattern it will not repeat tomorrow - it will move. With the past experience we found out how it has been moving. If Calcutta gets rain due to cyclonic storm today, three days later the rainfall pattern would move westwards and Allahabad and Delhi get rain. This is past experience and we believe today also that it would behave similarly. So with the past experience we used to know how weather patterns move. That is known as synoptic meteorology. How it moves in our country may be different from how it moves elsehwere. Also the pattern observed over past ten years may not exactly repeat in another timeframe. There might be anamolies from average. But a qualitative estimation is certainly possible. However since a long time people have been questioning the entire premise. It is a physical phenomenon - created by the distribution of winds temperature, humidity, pressure etc. The equations of motion, of continuity and thermodynamics are known for over a century. If we apply these equations to every part of globe it should tell what will be the fate of weather next hour or next day. This is the basis for quantitative forecasting. Thus if we can compute the behaviour of each part of globe in the next day or two, it is numerical weather prediction. But soon we discovered that movements in one part of sphere are affected by adjoining and distant parts. Electromagnetic field shows similar behaviour. A magnet is affected by electric current flowing elsewhere. An electric current and the magnetic field produced by it have a great similarity with vorticity. I believe that in future we will be able to make better forecasts on the basis of this electrical analogy. computation of future weather is based on the assessment of weather prevailing elsewhere over the globe. Data for numerical weather prediction became available only after satellites came in.

As far computers are concerned, there are six partial differential equations to describe the course of a parcel of air. Now six different partial equations of all neighbouring parcels are also required. The globe has been divided into 500 grid points and five levels. Thus there are about a million partial differential equations to be solved. The mathematical equations are such that they can give forecasts only an hour ahead. Therefore if we want a 24 hour forecast, 24 million equations are to be solved in an hour or two. A good fast computer is required for that purpose.

In 1983 April Punjab had a 3 days rainfall, which spoiled the crop. Prime Minister was worried. Prof. Yash Pal was called to investigate as to what could be done to improve our weather service to farmers. The farmers were asked about the current weather forecasting service which was for 36-48 hours in advance. After initial hesitation they confided that this was no use to them as no action could be taken such a this short period. If the forecast to be useful it must be provided atleast a week in advance. I quoted the American and European approach where numerical weather forecasting using a supercomputer was providing forecasts upto 10 days in advance with good reliability. Prof. Yash Pal asked me to write to PM. In a half page note I explained the need of a supercomputer for medium range forecasting. Since we have a satellite and arrangements for global data reception, we need a supercomputer which will cost 50 crores. It was accepted.

Regarding the question of expertise and training to take up this kind of numerical weather forecasting, I strongly defended the idea of indigenous effort against the view that an Indo-US collaboration was required. Afterall God did not tell Americans how to do numerical weather forecasting. Similarly I am confident that given the opportunity, Indian Scientists will also do the job. And it is also a must because the model developed by other established countries pertain to upper latitudes whereas we require models for tropical conditions. Luckily the Government of India accepted the proposal and has procured the super- computer. There was a question about the Super Computers location. A Committee was set up. It was in favour of Pune, which provided a better academic atmosphere and a better climate is necessary to take care of people, who will be mentally involved in this activity not doing a push button job. However a politcal decision has been made to locate the computer at Delhi. Eventually Indian scientists will be able to issue weather forecasts 7-10 days.

Q. Shall we also ask questions about your life and personal matters? You had an active research carrier spanning 40-45 years, how do you feel about this?

A. I have been very lucky. To pursue an active research carrier your domestic front should be happy. If you have got a sickly wife at home or a nagging wife, you cannot concentrate. My health has been reasonably good. That is also a matter of luck or circumstance. So I have been lucky. Scientific research or any other carrier requires hard work apart from brain power. I have been lucky as I got a good professor like Prof. Raman, who told me how to do research work. It has little to do with scoring first class marks in your exams.

Q. Could you tell us some reminiscences about Prof. Raman?

A. I recall many reminiscences with Prof. Raman. One of his questions in an interview was to ask for interview the length and diameter of a piece of pencil or some other handy object. This way he used to assess the faculty of mental estimation. Certain other innocuous looking questions were his favourites. Like, 'Why is glass transparent?' or 'Is rocksalt soluble?' If the correct answer is given he will ask further as to uses of rocksalt. He must know that rocksalt is transparent in infrared and is used for making prisms. And you cannot touch it as it would dissolve. I was a vacation worker with Prof. Raman where refundable deposit of Rs. 75/- was needed contrary to present day trend of getting scholarship for any work. In those days Rs. 75/- was a lot of money, about Rs. 2,000/- of today. He took me to the microscope and showed a mica sheet out of focus, which showed bands. The problem had been defined. He told me to go through a similar work of a German scientist running into 90 pages German. Looking at my blank face he told me not to worry and take help of German-English Dictionary. He further consoled me by saying that a person claiming to know German would take three days and that I might take 7 days. Thereafter almost every day before 8 am I used to go to him for guidance. He used to rise early in the morning and come to laboratory by 7 o'clock. We were 10 students there. In whichever room an individual was, he would enter and have discussion for half an hour.

After an year IMD asked for a man and he nominated me. To my querry that I am not the senior most person he gave the reason that I was 33 and at that age getting a Government service was not easy. For my Ph. D. degree he said you can get it later and regarding the temporary nature of the post he quipped, "Pisharoty, is life not temporary?". He also used to say "keep yourself warmer than what you need to be". That was the reason why he dressed always like a European. He believed that our handicaps could be overcome by greater thinking power and hard work. One day when I was depressed at the thought of some other lab having a powerful X-ray machine for crystallography, he asked me, 'What is the power of that machine?' I said '10 kw', and 'yours', I said '1 kw'. 'Then you put a 10 kw brain on it'. Such was the importance of brain power in his mind. He advised me in January 1942, to spend 10% of income on books and journals. I kept it up. But my wife started objecting to this scheme of spending a 10% chunk of income on books. My doctor told me, when you buy expensive books, buy a saree also. Since then there were no complaints. She may not be using all the sarees all the time, nor am I using the books always, but both are happy. If you are very much alert on your subject, your boss recognises it. In fact if he knows that you really 'know' the relationship becomes very cordial. Of course if you "show up", he will try to cut you down. Books and knowledge from them earns you affection and regard from your colleagues - junior and senior.

Q. Do you think there is need for motivation in life? Did you have such motivation?

A. Yes, I had motivation. Soon after my graduation, I realised that I am not going to be a rich man. What is the other alternative - to become rich in knowledge - whatever be the field. With that motivation I went to Prof. Raman who used to motivate with the triple virtues of ambition, courage and endeavour. Courage I did not have. But it is an essential ingredient for success in life. Because, even if you have a good idea you need courage to put it forward.

Q. In your presentation you quote so many 'shlokas'. Do you remember these or prepare in advance for the talk?

A. I prepare for it in the sense that I know where slokas appropriate to the context are to be found in my books and I look them up. I had an

advantage in this regard as I was exposed to a large number of Sanskrit 'Stotras' in my boyhood. My brother was educated in Sanskrit and used to enjoy reading from Sanskrit works of Kalidasa etc. Also large number of people who used to visit the temple repeated 'stotras'. My village had two houses - mine and a temple (of Siva). Thus I was exposed to Sanskrit in my early life. Later I was exposed to books like Brihadstotra, Ratnakara, Kalidas's works, Subhashita Ratna Bhandagara etc.

Q. Do you have any message for us?

A. Same as what Prof. Raman has often stated : Have ambition, courage and endeavour. And you can start any day. And there is no reason why you should not have a high ambition.

DR. T A HARIHARAN - BIOGRAPHICAL SKETCH

Dr. T A Hariharan was born on February 10, 1929 in Palghat, Kerala. He had his early education in his home town and had the distinction of standing first in B. Sc. (Physics) in Madras University in the year 1949. He took his M. Sc. degree in Physics in 1951 from Delhi University and soon started his career in research at the Indian Association for the Cultivation of Science, Calcutta. He moved over to the Department of Physics, Indian Institute of Science, Bangalore from where he took his Ph. D. degree in Physics in 1957. He continued his research work at IISc in a post- doctoral capacity on problems related to Molecular structure and advanced spectroscopic techniques. He joined the Karnataka Regional Engineering College and was Assistant Professor there for a couple of years.

Dr. Hariharan then joined the Space Science Center, University of California, Los Angeles to work on a NASA sponsored project as a Co-Principal Investigator. The objective of the project was to develop an optical instrument involving polarisation measurements which will enable to monitor aerosol effects on the Thermal IR measurements made in spaceborne atmospheric sounding.

After successful completion of the project, he joined the Space Science and Engineering Center, University of Wisconsin, Madison where he was involved in system studies on monitoring of typical anthropogenic environmental pollutants from space platforms using Raman effect as a possible technique.

Dr. Hariharn was invited to join ISRO in 1970 and was assigned to work at CNRS near Paris to build and bring to India a Thermal IR Scanner as part of a collaborative program initiated by Prof. Vikram Sarabhai.

Since his return to India in 1971, Dr. Hariharan was involved in the formulation of Indian Space Program Profile, in the early Remote Sensing experiments and in the preparations in the country for Landsat data utilisation.

Later he made many contributions to the overall ISRO programs in many capacities. He has been a member of many study teams, working groups and committees at ISRO and national levels. These include ADCOS, INCOSPAR, INCOSTEP, IMPA, INDO-USSR WG, ISRO-ESA WG, PAC (DST), INSA IGBP, RESPOND, IRS, IRS-1C, II etc.

He has been deputed abroad several times to various countries which include Brazil, USSR, USA, UK, Canada, France, W. Germany, Italy and Japan. He is a member of the Editorial Board of the International Journal 'Marine Geodesy', Editor-in-Chief of Journal of the Indian Society of Remote Sensing, Editor of INCA-87 Proceedings, Editor Proceedings, National Symposium on Application of Remote Sensing for Rural Development. He has also served as a referee to journals like Mausam, Indian Journal of Radio and Space Physics and Proc. Ind. Acad. Sciences.

In 1985 Dr. Hariharan was designated as Chief Scientist (Remote Sensing) with the powers of Deputy Director, SAC. He retired from ISRO on February 28, 1989 and he continues to be active with an assignment at Gujarat University.

ISRS-Ahmedabad Chapter records its appreciation of his services and wish him all the best.

SOME REMINISCENCES - T A Hariharan

The Remote Sensing Programme of ISRO has made phenomenal progress in just two decades since the first and famous experiment on the early detection of wilt root disease in Coconut palms in Kerala. Many may not know about the events that followed immediately after the first experiment. This was the time when I entered the scene and began my close association with Prof. P R Pisharoty.

My first assignment was to work at CNRS France to build a Thermal IR Scanner for India for Sea Surface Temperature (SST) measurement to help in prediction of monsoon. At that time an identical scanner was being developed by France to test a concept of a design for a future Geo- stationary Meteorological Satellite Payload.

Through this scanner we could bring to India some technology for indegenous Multispectral Scanner Development.

The second Remote Sensing Experiment we did has an interesting history. Mr. Blamont Denise was a student at Poona University for his M. Sc. degree in Geography. As part of his M. Sc. course he wanted to do a Remote Sensing Project involving aerial photography with CIR films in an agricultural village, Kedagaon about 60 km from Poona. He sought ISRO collaboration. The French Space Agency CNES assured him the services of a technician for photography and processing and also for providing the films (panchromatic, colour and false colour) and chemicals. ISRO agreed to provide three cameras, a helicopter, mounts for the cameras, processing facilities and all other logistics support and local hospitability.

Myself and my colleaue Dr. N V Madhavan Unni represented ISRO in this collaborative project. Luckily for us three Hasselblad cameras were available at PRL at that time. We arranged for a helicopter from the Naval Base INS Kunjali at Colaba Bombay, the frame for the Camera mount and the photo processing facilities were provided by TIFR and Poona airport and Poona University also provided some support. We had to work hard to coordinate between these various agencies.

To test the camera mount, we carried out a short flight in the helicopter from Colaba to a small Island in the bay and took some colour pictures. During the flight, the vibration was so much that I was afraid the cameras will get loose and fall into the sea. Fortunately it did not happen and only one lens cover flew off.

The French Technician Mr. Tamalet arrived with all the necessary materials and we faced some problem in clearing the customs. Mr. Tamalet could not speak English and that complicated matters further. I knew sufficient French to understand him but could not communicate to him in French.

After overcoming the initial problems, the experiment was conducted and we got excellent quality pictures.

Through this experiment we learnt the tricks of False Colour IR processing which could not be done in the country at that time.

Later we began plans for doing some experiment all by ourselves but this time we desired to use a Dakota instead of helicopter. We were using a Dakota at that time for our Scanner flights.

We selected some agricultural fields in Karjat near Bombay. We imported the films, chemicals etc. and also prepared a dark room in an apartment building which also housed the Remote Sensing unit.

We faced many problems. We needed security clearnace for aerial photography, clearance from civil aviation for flying the aircraft, a security officer has to be onboard the aircraft during photography, the processed films must be handed over to the security officer for clearance for use.

In the case of the Karjat experiment, by the time we could complete the formalities for the flying, the harvest was over and it was only bare soil on the fields.

We made one more attempt in another location south of Jaipur which also ended in frustration. Our next attempt was over Sriharikota and this proved somewhat successful. Part of the CIR imagery over SHAR adorned the front page of SAC Courier for a long time till it was changed by a SLAR imagery.

In the meantime we had imported many more Hasselblad cameras and returned to PRL the cameras we had originally borrowed. SAC was then ready for a major Project like ARISE. The cameras used to go bad often for want of proper maintenance. We sought the help of the agent through whom the cameras were imported but this was of no avail.

After consdierable negotiation we managed to send one of our Engineers for about 2 weeks to the factory in Sweden. During this short visit he managed to learn as much as he could and brought with him the appropriate tools which proved to be a great asset.

Since that time the defective cameras could be repaired and experiments could go on without interruption.

As is well known now many more joint projects followed ARISE and we entered the Space with Bhaskara and then on to IRS. With the formation of NRSA, Remote Sensing reached totally new dimensions with extensive resource surveys with advanced cameras along with MSS and Landsat data received and processed at NRSA.

Our efforts continued in the area of R&D and exploring new applications of Remote Sensing data which might lead to future operationalisation in the development of sensors and image processing techniques.

Society Announcement

NOW AVAILABLE

Proceedings of the Symposium on **Remote Sensing in Agriculture**, Ahmedabad, February 27-28, 1988. Edited by Baldev Sahai, Space Applications Centre, Ahmedabad

The proceedings contains articles on Sensors; Data Products and Information Systems; Crop Production, Yield Modelling and Crop Stress; Land Use and Land Degradation; Soil Mapping and Soil Moisture and a report on the panel discussion on Development and Management of Agricultural Resources in Gujarat.

The cost of the proceedings is Rs. 200/-.

Orders may be placed with The Secretary, ISRS Ahmedabad Chapter, C/o. Remote Sensing Area, Space Applications Centre, Ahmedabad. The money may be sent through MO/Cheque/DD in favour of ISRS-Ahmedabad Chapter payable at Ahmedabad. Outstation cheque should include Rs. 6/- towards bank charges.

Members of the Indian Society of Remote Sensing can buy a copy of the proceedings for their personal use by payment of Rs. 50/- (plus postal charges).

Dr. DADHWAL, CONGRATULATIONS AGAIN!

Dr. V K Dadhwal has been awarded INSA Young Scientist Medal 1989 for his research contributions in the field of agriculture. The award consists of a medal and a cash prize of Rs. 5,000/-. In addition the award also has a provision for research grant by the academy not exceeding Rs. 20,000/- including stipend for a JRF for a period of three years. Dr. Dadhwal had earlier won INSA Young Scientst Award 1987.

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