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My years with the CSIR

Hari Narain*

Setting up an Institute is a comparatively new and exciting discipline should be full of challenges. That was the way I looked at the invitation from Dr. Husain Zaheer, Director-General of Council of Scientific & Industrial Research (CSIR) when he offered me the position of Director of the National Geophysical Research Institute (NGRI) in 1963. The offer reached me on 21st September, my 41st birthday, and it came to me as a pleasant surprise. I was not an applicant. M.S. Krishnan, an eminent geologist and retired Director of the Geological Survey of India (GSI), first Director of NGRI appointed in October 1961, was due to retire in October 1963. This necessitated the search for a new Director and the offer came to me. I was Director of the Research & Training Institute (now known as KDMIPE) in the Oil & Natural Gas Commission (ONGC) at that time and had put in nearly 8 years of service, having joined the Commission as Senior Geophysicist when it was set up by the Government of India in 1956. The ONGC refused to release me but the CSIR offer was too attractive to let it go. I decided to resign from my position in the ONGC to join the NGRI in Hyderabad in March 1964 – a new and comparatively strange place for a family from Dehradun, two days and two nights away by train!

31st March 1964, is vividly engraved in my mind. I, my wife and two children arrived at Secunderabad by train in the morning and moved into a newly constructed quarter in the Regional Research Laboratory, Hyderabad (RRL, now IICT) which Dr. Zaheer was good enough to arrange for me. NGRI was housed in two rooms of the Department of Geology and in the basement of the Department of Chemistry of the Osmania University, where the total staff of scientists and scientific assistants numbering about 20 worked. The administration, stores and finance departments were housed in a rented building, not far from RRL. S. Balakrishna was the Assistant Director In-Charge of the Institute after M.S. Krishnan left. The handing over and taking over charge of the Institute took place the same afternoon, in the presence of all the staff. It was a pleasure to meet all of them. I never imagined that the next 19 years would be spent working with them and many others who were to join subsequently.

The immediate problems were to find space for scientific staff and laboratories, to draw up a charter and a plan for the Institute, to initiate consultations with the CSIR architect for office and laboratory buildings, to plan for recruitment of personnel and procurement of instruments and equipment. These tasks were to be discussed in the Executive Council and with the CSIR and had to be carried out simultaneously and with speed. NGRI was going to be the first and the only laboratory of its kind devoted to both applied and basic research, primarily in the fields of geophysics and earth sciences – subjects which are vital for exploration and exploitation of minerals, petroleum and groundwater and for understanding the basic principles of processes within the earth which determine the formation and accumulation of natural resources. Organizations such as GSI and ONGC were there where mineral and petroleum exploration were going on. Seismological studies were being carried out in India Metereological Department and some Universities. Survey of India was there to carry out geodetic studies, triangulation and countrywide gravity and geomagnetic measurements on a large grid basis. NGRI had to take note of all these on-going scientific activities in the country and draw up programmes of research and development which would supplement these studies and take the earth sciences into research areas which could provide both short-term and long-term benefits.

Earth sciences which comprise geology, geochemistry and geophysics have gone through a major revolution. The long standing controversy of continental drift, the interpretation of marine geoscientific studies and the pattern of earthquake epicentres and foci brought forth a synthesis of a variety of geodata of past 200 m.y. into a single and unifying conceptual framework of 'Plate Tectonics'.

The Indian region has played a crucial role because the Indian plate has been found to be the most mobile having covered a distance of about 80° latitude in past 150 m.y. period. Its collision with Asian plate has given rise to the largest and highest mountains of the Himalaya. On its oceanic part, there is the largest geoid anomaly which forms one of the most intriguing features in earch sciences.

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Basically the earth sciences apply themselves to two tasks: (i) exploration, evaluation and management of natural resources and assessment of natural hazards to meet the socio-economic needs, and (ii) answering questions such as what lies and what processes take place at the root of geological and tectonic features of continental and oceanic parts. From the very beginning, NGRI has consciously adhered to this bi-modal characteristics and strived hard to work towards the above objectives.

Earth sciences owe some of its first discoveries and concepts to the geological and geophysical surveys over the Indian region. The concepts of isostasy, high-temperature metamorphism, charnocktization, fluidity of core, Gondwanaland as outlined in the works of Airy, Fermor, Wadia, Pitchamuthu and others – which are now the corner stones of our understanding of earth's structure and dynamics – were first discovered in India. However, the technology explosion in the west, following the two world wars, resulted in a very large gap in our quantitative capabilities to map and study the earth. India with 5000 years old civilization and continued exploitation of natural resources had already depleted the mineral deposits at the surface. It was, therefore, essential to develop capabilities to explore deeper resources. Emerging problems of earth sciences both on applied and basic aspects, required high precision equipment and sensors, laboratories, observatories, data processing and interpretation methodologies and above all a pool of creative researchers and skilled manpower to accomplish the tasks ahead. This was the foremost challenge when NGRI came into being.

The immediate task before me when I joined the NGRI was to find more laboratory space for our scientists. Even though Osmania University had generously provided some space for nearly 2 years, it was too small for our requirements. It was lucky that RRL (H) had just completed construction of a large number of (G type) quarters and with great pursuation, RRL (H) agreed to give us about 10,000 sq ft of space in these quarters to house the NGRI laboratories. There was open space adjoining these quarters and we were able to put up sheds in no time for our workshop and maintenance services. We continued to work in these quarters for nearly 6 years till the main block of NGRI was ready for occupation in March 1970.

The support I got from Husain Zaheer and D.N. Wadia, the first Chairman of the Executive Council, was of immense help in embarking on the multi-faceted developmental activities of the new institution. Andhra Pradesh Government was extremely generous in donating 150 acres of land adjoining the campus of RRL (H) and agreed to provide all necessary facilities including water and power, for a new institution coming up in the State.

At the first Executive Council Meeting of NGRI, Dr. Hari Narain with Dr. Hussain Zaheer and Dr. D.N.Wadia.

The designs of the Institute were prepared by Bharadwaj, the CSIR Architect, with great care keeping in mind our requirements. Of course, this required

NGRI Scientists and staff in G- type of quarters - January, 1965.

detailed discussions with the scientists and the architect with all his new ideas was extremely accommodating to the views and suggestions of the scientists. He did a quick job and we were able to call for tenders and decide on a contractor in early 1965. Unfortunately, the Pakistan war came soon after and the entire construction programme had to be postponed. It was only in January 1967, when the late Smt. Indira Gandhi, the-then Prime Minister, came to Hyderabad to inaugurate the Indian Science Congress in OsmaniaUniversity, that we got the opportunity to get the foundation stone of the Institute laid by her. It was a miracle, in a way, that even though we had no money and the Prime Minister had no time, we were able to get her to lay the foundation stone on 3rd January 1967.

NGRI foundation stone being laid by Smt. Indira Gandhi, Prime Minister of India on 3rd January 1967.

In my welcome address I said:

"our knowledge of the earth has grown since the appearance of man on the planet. However, studies of the earth have remained considerably limited and our knowledge is extremely meagre. Today, we know much more about fundamental particles and the nuclear forces which hold them together to use nuclear energy for economic purposes and for war. We know sufficiently enough of the solar system and space to accomplish space flights and to plan for landing on the moon. In all this rush towards the two extremes – the nucleus and space – the solid earth on which we live and from which we derive all our resources has remained neglected."

Late Dr. Atma Ram, the then Director-General, in his address said that this laboratory devoted to the earth sciences and to the exploration of natural resources of the country should have been one of the first to be established. In her address, Mrs. Gandhi said:

"the distant stars may look more glittering, but this Earth, our own star, is also full of beauty and riches waiting to be discovered. Dr. Hari Narain remarked on the neglect of geophysics all over the world; how true was his observation that today man is more obsessed by the mysteries of outer space than by the composition of the earth he walks on, the ocean he sails and the mountain he climbs". She further said "India has a truly unique location for geophysical research, that everything is here and the challenge too. I hope this Institute and the work it does will excite the imagination of our people with the tasks it undertakes."

This function was followed by a three-day International Symposium on Upper Mantle Project which helped to give some directions to the Institute for its scientific programmes.

Reviewing Geophysical Symposiums in India held in NGRI, Hyderabad in 1964 and the latest one in 1967, L.C. Pakisar of USGS wrote in Atlas (News Suppliment to Earth-Science Reviews) of September 1968 that

"In both volumes, the effective leadership of Hari Narain, Director of National Geophysical Research Institute and Secretary of the Geophysics Research Board, is evident. 1967 Symposium was International.Scientists from Japan, South Vietnam, USA, USSR and West Germany attended and presented papers. "By western standards, these contributions are modest, but they reveal encouraging evidence of the stimulating effect of the Upper Mantle Project on Indian science and demonstrate clearly that India, under the leadership of such men as Hari Narain, is developing a balanced program of research in the earth sciences in order to help solve India's economic problems, and to contribute to the mainstream of culture-enriching science in the world community."

Science & Technology agreement signed in Prague between CSIR and CESKOSLOVENSKA AKADEMIE VED

Soon after the laying of the foundation stone, we started pestering CSIR to provide funds to start the construction. The contractor who had submitted the quotations some time in the middle of 1965 had to be pursuaded to take up the work even though the rates had gone up during this intervening period. Since the total money for the entire building was not available, the work had to be taken up in parts and we were lucky to persuade the contractor to agree to that condition as well. Thus, it was bit by bit, portion by portion, that the main block of the Institute could be completed by March 1970. The Library, two other blocks, workshop and housing colony came up later.

Paucity of funds and more so of foreign exchange prompted me to enter into collaborative projects with the USSR Academy of Sciences, National Science Foundation of USA and Federal Institute of Geosciences in Germany during the early seventies and UNDP in the early eighties, to obtain precision instruments and much needed equipment. It goes to the credit of our scientists that within a short period of 10 years they brought to NGRI national and international recognition as the premier institute in earth sciences, through their publications in reputed journals, field operations, airborne and seaborne geophysical surveys and mineral discoveries in some remote areas.

Dr. Hari Narain in discussion with Prof. Vinogrodov, President of the USSR Academy of Sciences who visited NGRI in 1972.

In the next few years, the Institute developed infrastructure and national facilities in geophysical instrumentation, laboratory and physical modelling for electrical and electromagnetic studies in mineral exploration, R-C network system for geohydrological studies, geothermics, palaeomagnetism, rock-mechanics and seismological, geomagnetic and geoelectric observatories.

Dr. Hari Narain with Shri K D Malviya.

Over the years, surface-wave studies for Himalayan mountain building and continental crust studies in Bay of Bengal, Body wave studies and Uper Mantle structures in different parts of the earth, seismic zoning, earthquake evaluation, reservoir induced seismicity in Koyna region, deep seismic projects in differents parts of the country, airborne geophysical surveys, gravity studies and anomaly maps of India, geomagnetic, palaeomagnetic and magnetotelluric studies were carried out by the scientists which brought credit to the Institute.

While reviewing the research projects of the NGRI during the year 1968-69, B.C. Roy (Retired Director-General, Geological Survey of India), Editor of the Jounral of Mines, Metals & Fuels wrote in his Editor's Corner,

"the National Geophysical Research Institute has made a stride in national and international geophysics during the short span from its inception. It is no exaggeration that the Institute has developed indigenous instrumentation and techniques for airborne geophysical surveys and is capable of undertaking such surveys. It would seem unwise and uneconomical to fall in for French and Russian aid, particularly when the costly and much wanted US-AID Operation Hardrock programme is yet to show concrete results. Although young, the Institute has shown greater initiative and has achieved commendable progress in the field of instrumentation and techniques in airborne geophysics, vis-a-vis other sister organisations in the country. Government can ill afford to ignore the possibilities the Institute could offer towards the nation's mineral and groundwater resource development."

The Institute carried out a number of detailed surveys for mineral exploration using integrated airborne, magnetic, ground gravity, electrical and electro-magnetic surveys.

In the following year again in the Editor's Corner of the Journal of Mines, Metals & Fuels, the Editor, B.C. Roy reviewed the Annual Report of the NGRI for the year 1969-70, under the heading: 'NGRI Forges Ahead'. He said,

"India has pressing need for assessing her mineral and water potentialities, and in this regard geophysics plays a vital role, and naturally, we are interested to watch the country's progress in this discipline. The important organisations accredited with geophysical research and exploration in India comprise the Geological Survey of India, the Oil & Natural Gas Commission, the National Geophysical Research Institute, the Atomic Energy Department and the Oil India Limited. Whereas the National Geophysical Research Institute offers us an opportunity to review its work in detail from year to year, the activities of other organisations are not known to the layman and Indian scientist alike due to lack of timely and periodic reviews of their work. And, therefore, we are happy to see the Annual Report of the NGRI.

The Institute has maintained its greater initiative as compared to the country's costlier sister organisations. The credit goes to the Institute's young and brilliant scientists under the inspiring leadership of its Director. Government must recognise the potentialities of the NGRI and offer greater responsibilities for work on the various frontiers of solid earth geophysics."

In December 1970, the Institute held the Second Symposium on the Upper Mantle. A number of foreign scientists participated. Dr. J.C. Dooley of the Australian Bureau of Mineral Resources and Chief of Geophysics Division was one of the foreign participants in the Second Symposium on the Upper Mantle Project. Writing for the 'News Letter' of the Commonwealth Geological Office, London in its issue of March 1971, he said,

"The main impression gained from the Symposium was of a substantial increase in geophysical investigations of the Upper Mantle in India during the last five years or so. Particularly notable were the contributions of the National Geophysical Research Institute in Hyderabad, in which building the Symposium was conducted. From small beginning in 1962, this Institute has blossomed into a fluorishing and active contribution to geophysical research under the capable directorship of Dr. Hari Narain, in the fields of seismology, gravity, heat flow, palaeomagnetism, geomagnetism and geoelectricity. There is also a strong theoretical geophysics group."

His specific remarks about Session II dealing with Solid Earth Geophysics and Session III on Palaeomagnetism and Continental Drift were as follows:

"In opening Session II, Dr. Tandon who recently retired as Director of the Seismological Section of the Meteorological Department, gave a comprehensive review of recent research in seismology in India; Dooley presented a review of seismological studies in Australia. Several investigations using earthquake waves were reported; of particular interest was a paper by Kaila, Krishna and Narain, in which the velocity structure of the mantle under Japan was determined in detail by a new method analysis; this is a development of a method of Gutenberg and can be applied to zones where earthquakes occur.

In Session III, Professor Ahmad gave a comprehensive review of continental drift, sea-floor spreading and associated phenomena; he favoured an earth expansion hypothesis as an explanation. Dr. D.P. McKenzie of Cambridge University presented the current state of knowledge of plate tectonics and indicated some of the problem areas where further investigations are needed."

Dr. D.P. McKenzie of Cambridge University in a personal letter after the 2nd Upper Mantle Symposium wrote in January 1971. The letter is reproduced below:

"Dear Dr. Hari Narain, Thank you very much for inviting me to come to your Upper Mantle Symposium which I have enjoyed very much indeed. I was especially impressed by the work which younger people were doing all over India, but especially those in your own Institute who seemed to me some of the brightest workers in seismology and geomagnetism, I have met anywhere. The other thing that impressed me very much was that all of them respect you for the battles you have had to fight for them and trust you to look after the interests of good geophysical research in the various high committees. If there is any help that either I or Drake can give you privately or through the Geodynamics Committee do please let us know. I feel as you do that investment in Earth Sciences education in India will make the country make prosperous in a direct and rapid way, and also that the subject is one of the most exciting scientifically at the moment. I and Le Pichon both agreed to go out of the International Committee because we thought we might be able to do something to help earth sciences in the developing countries, and I feel the potential here in India is greater than anywhere I have yet visitied; if you can keep the people you have already and attract more of the same quality, I am sure you can produce an enormous change. I am delighted that you invited me, and am grateful to both you and your wife for making me feel so conformtable and at home.

Yours sincerely
Dan McKenzie"

The fabrication of the physical model facility and results there-from to understand the host-rock effect in the field of geoelectromagnetics has been acknowledged as a pioneering effort.

Dr. Hari Narain with Shri C. Subrahmaniam showing prototype geophysical instruments at NGRI.

Development of totally indigenous multi-parameter airborne analog and digital equipment was the first Indian effort towards remote sensing of natural resources and earth structures. By measuring the magnetic field rather than its time derivative, NGRI group has brought forth a novel innovation at the cutting edge of this class of technology, providing far superior penetration to detect deep seated and over-burden covered targets in comparison to any other system in the world.

Development of GS-100 for ground EM, owing to its range and versatility has been rated as a front-rank field equipment by the experts of UNDP.

Organisation and management of scientific research is an art, in addition to being a science. One has to take into account not only the scientific capabilities and qualities of leadership, but also human aspirations and jealousies and attitudes towards both colleagues and their scientific interests. Creative persons, be it in arts or sciences, have to be nurtured with care and their sensitivities have to be respected. I was lucky to find senior scientists with qualities of leadership and spirit of accommodation to form groups to take up both applied and basic research with a number of brilliant research fellows recruited fresh from the Universities and a few scientists selected through advertisements.

In the applied areas of geophysical activities we went for the first time in the country into airborne geophysical surveys, groundwater investigations including computer modelling and management, geophysical instrumentation, deep seismic sounding and a few other fields. NGRI was the first to fly over Kudremukh-Kotebare region on the western coast in April 1967 even before the USAID-supported Hard Rock Project of the Geological Survey of India with foreign aircraft, equipment and technicians commenced work.

Areas of basic research were selected which had excited the imagination of geoscientists the world over since the beginning of this Century and which were within the capabilities and interests of the NGRI scientists oriented towards theoretical studies. Laboratory work including modelling experiments, geochemical investigations and field surveys formed part of the other scientific programmes of the Institute.

Indian science has been notorious for its 'crab' mentality and NGRI could not be an exception. Some of the members of the Executive Council and a few geoscientists both outside and inside felt jealous and alleged that NGRI was going beyond its charter in establishing observatories, carrying out aerial surveys and groundwater and mineral investigations. A number of commitees were set up by the CSIR, the Ministries and the Planning Commission to confine NGRI in a cocoon, to carry out only research work in geophysical exploration and interpretation. I was carefully excluded from these committees and wasn't even called for a hearing. Things grew so bad in 1969 that I was forced to resign. Soon Directors of a few other CSIR laboratories, who were also under similar stress, resigned or threatened to resign and the President of the CSIR, Mrs. Indira Gandhi, had to intervene. My resignation was not accepted. I was provided full support, and the Executive Council of the Institute was held in abeyance and later reconstituted.

The situation improved considerably soon after. The Government had plans to bring French, German and USSR companies to carry out airborne geophysical surveys in the country. I seriously objected to the proposal because NGRI had developed all the facilities for such work and our electromagnetic survey equipment was decidedly superior to what was available with the western companies at that point of time. The matter went up to the Central Cabinet and the Cabinet Secretary called me to assure that besides the agreement signed so far, no foreign companies would be called for such surveys in the future.

In the early seventies, I was made a member of the newly formed National Committee on Science & Technology (NCST) and NGRI scientists played a significant role in formulation of NCST plans for natural resources sector which included minerals, coal, petroleum, land, soil, forests, water and

environment. It was for the first time in the country that an integrated S&T planning for the entire sector was undertaken to be dovetailed with the economic plans of the Planning Commission.

In April 1972, the Department of Science & Technology, Government of India asked me to immediately proceed to Dehradun and take charge temporarily of the Survey of India. I was told that the Surveyor General Brig. J.S. Paintal had been dismissed from the service with immediate effect and I must take over as Surveyor General till further orders. The request came from Shri C. Subramaniam, Cabinet Minister for Science & Technology and there was no question of avoiding it, even though, I was hesitant to take charge of the oldest and possibly the largest scientific department of the country set up by the British in 1767 about which, I hardly knew anything about its functioning and its problems. This charge was in addition to my position as Director, NGRI.

The three months additional charge as Surveyor General continued for four years till April 1976 when Brig. K.L. Khosla, the senior-most officer in the department took over charge from me. During these four years, I was dividing my time between Hyderabad, Delhi and Dehradun and I made sure that the work of either of the two institutions or the NCST did not suffer in any way. I established a new Directorate of Research in the Survey Offices in Hyderabad and also brought in a number of changes big and small to streamline the operations.

While in Survey of India, I was simply shocked to seeing the status of cadastal surveys in the various states of the country. This prompted me to get the status reports prepared for each state and I volunteered to depute 2 or 3 competent survey officers of the Survey of India to the states to update their survey network and tie them up with the Survey of India Survey Network. The offer to the states was made by Shri C.Subramaniam, Minister for Science & Technology and it was followed up by me through my letters to the Chief Secretaries of the various states. It was unfortunate that except for Tamil Nadu and Karnataka, where the cadastal survey status was comparably much better, no other states responded to our offer. It is unfortunate that the basic maps of land use still remain in the hands of Patwaris with little understanding of the modern survey techniques and need for high degree of accuracy in our cadastal surveys.

In the Survey of India, many anomalies had crept during the years of its existence and I took interest to resolve as many as I could. There were problems between the civilian and army officers and I had to go to the Cabinet Secretary to resolve some of them. The various associations and unions needed my personal attention and intervention to remove their grievances.

During the four years time with the Survey, I visited number of the offices in different States, made a few trips to Rangoon and held one tripartite meeting in Dhaka in Bangladesh with Burma, Bungladesh and India to decide the trijunction of the International boundaries between Burma, Bangladesh and India. The work was strenuous but enjoyable and I have fond memories of the respect and affection which the officers and staff of the Survey of India gave me during my association with them.

In April 1978, I was called by Shri Morarji Desai, the-then Prime Minister and President of CSIR, and asked to go to Banaras Hindu University as Vice-Chancellor. I was reluctant but I wasn't heard. Deputation from NGRI to BHU for 3 years was arranged and I was away in Varanasi from May 1978 to May 1981. Amalendu Roy and later S. Balakrishna served as Directors during my absence. The Institute continued to grow in stature and importance through its publications and survey activities during this period. I came back in May 1981 and retired in March 1983. Vinod K. Gaur succeeded me as Director.

I have tremendous satisfaction and pleasure that during my tenure an Institute in Earth Sciences, the only one of its kind, established with the full support of the CSIR and the commitment and dedicated work of its scientists, won laurels like Bhatnagar Prizes and INSA Fellowships. I was awarded a Padma Shri by Government of India in 1974.

During the course of years, a number of foreign and Indian dignitaries visited the Institute. Comments of a few of them are reproduced here:

"I had visited this building in its stage of construction. It is a great pleasure indeed not only to see the buildings completed and equipped but also most useful and important work being done by a wonderful team of dedicated and devoted Scientists who undoubtedly are a pride of India. I wish them all success.

Govind Narain, I.C.S.
Defence Secretary to Government of India
5.12.1975

As a manuscript mirrors the mind of its author, and as the personality of an artist shows through his masterpiece, no matter how we would point it out – so the character and intregrity of the head is revealed in every aspect of an institution.

First impressions of this National Geophysical Research Institute was of neat gracious buildings in a well ordered campus. The fine image is confirmed and intensified with increasing depth and intimacy of contact with the scientific professional and technical work at all levels.

Responsibility for this pervasive excellence must flow ultimately from the Director who has moulded it from a barren field and an empty establishment list.

The institution itself – gardens, mortar, people, publications, inspiration is Dr. Narain's monument. He has every reason for pride.

By his works, we know him.

S.W. Carry
Hobart University, Australia
28.9.1976

I spent a very interesting and educative one hour seeing the different divisions of the Institute and acquainting myself with the very useful fundamental work of Geophysical research being undertaken. Without a visit to this Institute, I would not have been able to assess the great national worth of the work being done. The line of research covers an area far out of reach of the common man or the desk-tied administrator but its importance for every desk work can hardly be minimised. It is interesting to remember through the instrument of science – one can find and so many relevant facts about the environment on and round which the "humans" lead their daily life and to feel at the same time the vast bounds of knowledge which are still unexplained though they would mean so much to make the planet a much more worthwhile place to live in. The work being done is of a quality which transcends what one generally thinks and comes across. I congratulate Dr. Hari Narain and his colleagues for the excellent work they are doing and for the opportunities that come their way to do solid national service in the field as well as in the laboratory.

I wish them and the Institute every success.

V. Shanker,
Principal Secretary to Prime Minister
26.8.1977

I have been to NGRI on earlier occasions. But this is my first formal visit since I took over as Director General, CSIR. I was very happy to go round the various laboratories and to see the extent and quality of work being carried out. There is wide spectrum of research and development work in progress – covering aspects that are important for basic understanding in the geosciences, to work of practical and national relevance. NGRI today has got the base to provide leadership and lend support to many areas of interest in earth sciences. These are areas that we should pursue with vigour and determination: geophysical instrumentation, hydrogeology, airborne surveys, seismology and deep seismic soundings, properties of rocks, heat flow characteristics etc. NGRI has multiple techniques available in terms of the inter-disciplinary work, lead to exciting science and practical value. I would like to wish all staff of NGRI the very best in these efforts.

M.G.K. Menon, F.R.S.
26.2.1979

Abdus Salam, International Centre for Theoretical Physics, Tristie

Remarkable work being carried out – I am learning so much which will be useful for the International Centre at Tristie, in planning future activities. My congratulations for the work here.

Abdus Salam
Nobel Laurette
29.1.1981

Sadequian, Pakistan Artist

Apart from the remarkable function of the building of the NGRI, even its architecture is so good that I was immediately inspired by it. Of that inspiration transformed into a small mural pertaining to the function of the building.

The hospitality, the personal, and so many qualities of the staff will always be my cherished memories. I am so much grateful to great Dr. Hari Narain for this wonderful experience.

Sadequian
24.3.1982

Famous Pakistan artist Sadequian painting moral in the Main Hall of the NGRI.

During my two days visit to the NGRI, I have seen only some of its activities. But what I have seen convinces me that this Institute is the best equipped and the best run of any scientific Institute that I have visited in India.

The work that it is doing is impressive and of great scientific value. I am sure that Sir S.S. Bhatnagar would be proud, if he were alive, to find that the seed that he sowed has borne such good fruit.

With such foundations laid the Institute should grow from strength to strength and give India a high position in the world of geophysical research.

W.D. West
Sagar University
18.12.1982

On January 9, 1987 my colleagues: V.I. Tkatchenko and V.V. Arkhigov and myself have devoted all the day to get acquainted with the activities of NGRI. We have seen the high level of research and vast coverage of problems of research. In 1967, Mrs. Indira Gandhi had laid the foundation stone for the Institute building and now NGRI is a major scientific institution, the cooperation with which would be useful for geophysicists of the USSR and other countries.

With best wishes of success to the Institute personnel.

Academician A.L. Yanskin
Moscow, USSR
9.1.1987"

A CSIR publication in August 1988 titled "In Search of Knowledge – CSIR Contribution", analysed the performance of its various laboratories on the basis of their publications and citations etc., from 1950 to 1983 (the year of my retirement). It gave me immense pleasure to find that NGRI stood fourth in order of merit after NPL, NCL and CDRI, even though it was established much later compared to these well established laboratories. There could not be greater joy and satisfaction for a person, who along with his colleagues had toiled hard through thick and thin, to find that scientists and other staff of the Institute gave their best to merit such recognition within the CSIR family and established a place for the NGRI, both nationally and internationally, in the field of earth sciences in a short span of about 20 years !

While I was still Director, the Institute got a second UNDP Project in 1982, specifically with three objectives: (i) to get the ground electromagnetic instrument developed under the first UNDP Project tested for its response under different geological conditions; (ii) to undertake integrated geological and geophysical studies in the Cuddapah Basin of South India with a view to understand the structure, tectonics and evolution of this Proterozoic basin; and (iii) to undertake geochemical, geological and geophysical studies in selected parts of Andhra Pradesh around Wajrakarur to search for diamond-bearing Kimberlitic pipes.

Dr. Hari Narain awarding the IGU Decennial award to Dr. Mahadevan.

After my retirement in March 1983, UNDP was good enough to appoint me as National Project Coordinator for this Project which continued till December 1986, and thus my association with NGRI continued in a different capacity. The project added another dimension to NGRI field activities. The electromagnetic instrument was designed and successfully field tested by D. Guptasarma under different geological settings. This gave experience and confidence to scientists in its use for mineral exploration. The Cuddapah Basin studies resulted in a number of publications. The most exciting achievement was the finding of a new Kimberlite dyke with diamonds of gem variety. The exploration operations were handed over to GSI. The NGRI find proved to be the best among many other pipes found by GSI.

There are many success stories of the NGRI. But there are painful stories also and some of our serious efforts did not bear fruit due to slow and defective decision-making processes at higher levels in the Government. Successful completion of projects on airborne multi-parameter geophysical surveys, groundwater investigations and management in some basins and geophysical instrumentation gave us confidence to propose the formation of 3 subsidiaries in the NGRI, one for each of these three activities, to be run on conmmercial lines, with the latest advances in technology flowing from the Institute to

the subsidiaries and the problems of the subsidiaries fed back to scientists in the Institute for solution. And the NGRI was the most appropriate Institute to do so with all the expertise in theory, modelling, field and instrumentation available under one roof. The profits from the subsidiaries could easily provide all the funds to run the NGRI. The CSIR felt happy with the proposal initially and the Planning Commission even earmarked rupees one crore for the 3 subsidiaries in the V Plan period. But the CSIR got cold feet later and the plans never took off the ground. If approved, these subsidiaries could have contributed a lot to the economic development of the country. Airborne geophysical surveys of the entire country would have been completed long back. Groundwater studies in many watershed areas would have ensured scientific water management. And the country could have become self-sufficient to a large extent in production of sophisticated geophysical instruments for use in universities, research and survey organizations.

With the support of UNESCO and later that of USGS, NGRI wanted to undertake large-scale seismological studies for earthquake hazard assessment and basic understanding of the earthquake process. We could not get approval from appropriate Government agencies for these studies. ECAFE (now ESCAP) wanted to undertake off-shore geophysical surveys in the economic zone of the sub-continent in collaboration with NGRI. But the proposal was not agreed to. There are other instances where NGRI did not get the support it needed to take up investigations of value to science and to the country.

NGRI is a great Institution. It has some of the most productive geoscientists in the country. India has many exciting geological problems with the Himalaya in the north which constitutes an active continental plate collision zone and the peninsular shield in the south with over 3000 million years of earth's history buried in different rock types. It has the largest lava flow in Central India known as the Deccan Traps and many other extraordinary geological features worth study. It has much mineral wealth and large petroleum and natural gas potentiality, coal, diamonds and much else. There are many challenges offered to our geoscientists and I am confident the NGRI will continue to play an important role in the years to come.