SCIENCE NEWS

NEW HORIZONS IN UPPER ATMOSPHERE RESEARCH*

India's achievement in the field of upper atmosphere in the past has been remarkable. The high point was the publication (in 1947 and revised form in 1952) of S. K. Mitra's famous book 'The Upper Atmosphere'. Generations of students in radio communication, in ionospheric and upper atmospheric physics, in geomagnetism, in space science in this country and abroad have been using this book as a major reference document. It considered for the first time — a remarkable achievement considering the period — the atmospheric environment as a whole including both neutral and ionized part and covering all heights from surface to many hundreds of kilometers.

The next major thrust came during the International Geophysical Year (IGY) spanning the period 1 July 1957 to 31 December 1969. IGY marked a watershed in Indian scientific efforts on the study of our planet and the sun. A number of new techniques were launched on the Indian scene: the riometer (essentially an Indian discovery that used the radio noise from the galaxy to explore the ionosphere), installation of the Markowitx Moon Camera (specially designed by the U.S. Naval Observatory) at Nainital (20 such cameras installed around the world) reduced uncertainties in the distance between continents to about 90 feet, specially after the installation of Baker-Nunn camera at Nainital for tracking of satellites.

Perhaps the single most important event of IGY was the launching of satellites. With it came a revolution in our concept of atmospheric environment, of radiation interacting with this environment, the discovery of the magnetosphere and the radiation belt and a new description of the geoid.

The next international programme was the International Quiet Sun. This was planned to coincide with the period when the sun was least active. The period was 1964–1965. It was during this period that India set up its rocket launching facility at Thumba.

By this time the Indian scientific community in the upper atmosphere was organized, coherent and vibrant.

New Problems:

In the last few years, a number of global problems have come up demanding a new look at the upper atmosphere.

The first is the ozone problem. It has become clear that there are several human activities that may drastically deplete global ozone. These include: nitrogen oxides from subsonic and supersonic aircrafts, nitric oxide from agricultural and combustion practices; clorofluorocarbons (CFC's) used as aerosol propellants from blowing agents and refrigerants; carbon monoxide and carbon dioxide from combustion processes and methane from a variety of sources including natural and agricultural wetlands, Tundra biomass burning and enteric fermentation of ruminants. The most critical among these are CFCs.

While no conclusive evidence of the ozone depletion has been found in a global sense, there has been a dramatic discovery of a drastic ozone depletion occurring in the Antarctic by about 40% from 1968 to now, and occurring principally in the spring period September–October. The question asked is: why the Antarctic and why in October?

The second problem that has been thrown up is the existence of a large number of greenhouse molecules in the atmosphere and not just CO_2 — a fundamental change from the situation before 1960. The important non-CO_2 gases are CFCs, methane, nitrous oxide, ozone and stratospheric water vapour. In India so far the n easurements are limited to ozone (quite extensive) and of water vapour united to lower part of troposphere).

The third question concerns atmospheric chemistry. The scene has changed during the last two decades. In 1960's the thrust was on the ionosphere. In 1970's this scene shifted to the planetary atmospheres and ionospheres. The scene has now again shifted to the stratosphere and the troposphere.

The fourth major question concerns the interaction between the sun and the atmosphere. The sun is responsible for the production of the ionosphere, the aurora and the airglow, the dissociation of oxygen, the production of ozone and in the chemistry of many of the minor species. The flux reaching the earth (the solar constant) does not change much although new measurements by radiometers on

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* Extracts from the V. Ramakrishna Memorial Lecture delivered by Dr A. P. Mitra at Indian Institute of Technology, New Delhi on 29 January 1987.

board the orbiting satellite Solar Maximum Mission, have shown changes of 0.1 to 0.2% over a short period.

Indian Middle Atmosphere Programme (IMAP)

To answer some of these questions a new international programme has been launched in which India's participation is massive. This MAP — the Middle Atmosphere Programme — began in January 1982 and will continue up to March 1989. Here the thrust is on a relatively narrow part of the atmosphere, from about 1 km to 90 km. The programme seeks to answer the following questions: (a) what are the possibilities of damage to earth's middle atmosphere from man's activity? (b) what role does middle atmosphere play in determining climate and climatic changes? (c) what are the processes by which the sun, acting through the middle atmosphere, may be able to affect weather?

Indian interest in this programme arises from several excellent facilities that now exist (3 rocket ranges, a balloon facility in Hyderabad, a network of ozone station, existence of MST radars and lidar) and the desire to understand the role of the middle atmosphere in monsoon circulation and tropical atmospheric chemistry.

In addition, a new major facility is coming up in India — the so-called MST Radar — a new generation high power coherent pulsed doppler radar operating around 53 MHz and capable of probing the atmosphere from the surface to about 100 km.

IGBP

Over the years, from the period of IGY to now, our concept about atmospheric science has changed drastically. We now view the atmospheric environment as one entity. From the the ground to the boundary of the magnetosphere, the many classically recognized regions — troposphere, the stratosphere, the mesosphere, the ionosphere, the magnetosphere — have now merged, and coupling between various levels has been recognized. However, the boundaries have been erased only with difficulty, and in many countries, as in ours, only incompletely.

The most important weakness has been complete neglect of biosphere-geosphere connection. Global habitability or global change works through interactions between the sun, atmosphere, oceans, lithosphere and biosphere, only a few of these have in the past been interrelated. The International Council of Scientific Union have now adopted a programme that seeks to detect and examine interconnections between these fields and perhaps cross the barrier between physical and biological sciences.

Future efforts in India may well be directed to some or all of these areas. India is fortunate to have a strong interaction between physical and biological scientists. It would be important to take advantage of this interaction.

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NEWS

WHO'S 40TH ANNIVERSARY CELEBRATIONS

The World Health Organization will be 40 years old in 1988! Its 40th Anniversary year could be the occasion for a gigantic mobilization of social forces working towards the goal of "health for all by the year 2000".

How could the anniversary of WHO's birth be used to sensitize public opinion, health workers, politicians and others to questions of health development?

The Editor of *World Health Forum* invites you to send him your ideas (in about 200 words) for activities at the local or national level that could be organized during the 40th Anniversary year. The most innovative suggestions will be published.

The manuscripts may be sent to: The Editor, *World Health Forum*, World Health Organization, 1211 Geneva 27, Switzerland.