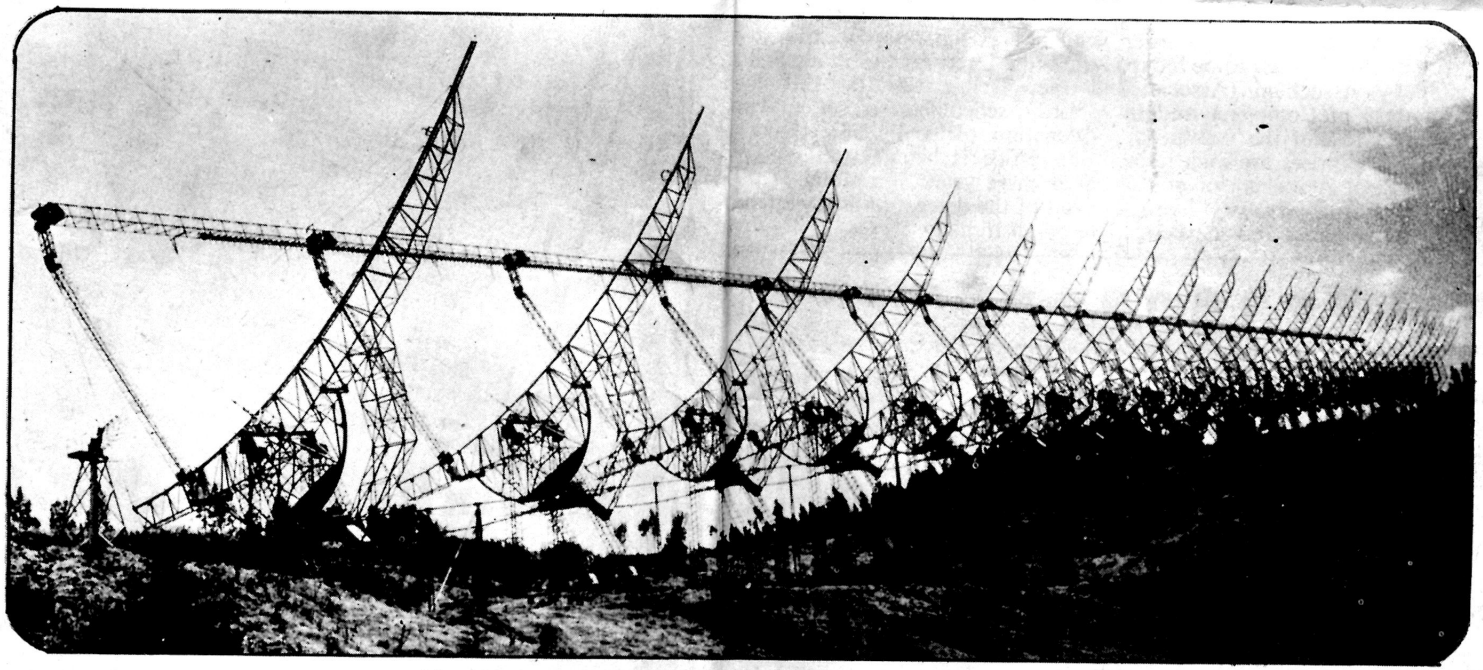
Wanted: new ideas to explain extragalactic energy sources

Astronomers from all over India met last week at Gorakhpur under the aspices of the Astronomical Society of India which was founded nine years ago. DR JAYANT V NARLIKAR, eminent astronomer and astrophysicist, discusses some of the questions that concern astronomers now

INDIA can boast of glorious traditions in astronomy in its ancient past, with names like Aryabhata and Bhaskara. Unfortunately, there was a serious gap of several centuries, with the exception of Maharaja Sawai Jaisingh (1689-1734) who built a series of observatories in Jaipur, Delhi, Ujjain and other places. India remained more or less isolated from the exciting discoveries by European astronomers, discoveries heralded by Galileo's use of the telescope with a lens.

However, since independence there has been a spurt in astronomical activity in the country and the Astronomical Society of India (ASI) was founded in response to the need of the growing band of professional astronomers to have a common forum for meeting, discussion and publication of results. Its present membership of around 300 includes some amateurs as well as a few foreign members, apart from the professionals employed in various observatories and institutions all over India.

To name some of the various astronomical activities, there are one-metre class of optical telescopes at the Indian Institute of Astrophysics (IIA), the Osmania University and the Uttar Pradesh State Observatory (UPSO). Indian astronomers are looking forward to the completion (in 1983?) of IIA's 2.2 metre telescope at Kavalur, while UPSO is planning a 4-metre telescope in the following decade.



The 550 metre radio telescope at Ooty (Pic Bharat Upadhyaya)

The Tata Institute of Fundamental Research (TIFR) has a group of theoretical astrophysicists in Bombay. It has, however observational and experimental facilities in astronomy located outside. The 550-metre radio telescope at Ooty is a national facility. The balloon launching facility at Hyderabad is used for measurements in infrared and X-ray astronomies. There is a gamma ray astronomy station in Ooty while deep underground in the Kolar Gold Fields (KGF) experiment is underway to detect the decay of a proton.

The Physical Research Laboratory in Ahmedabad and the Raman Research Institute in Bangalore are also conducting researches in theoretical and observational areas of astronomy. Sadly, in all this growth which has come about in the last two decades, the universities have been left far behind. With few exceptions like Osmania University at Hyderabad and Punjab University in Patiala, teaching and research in astronomy at universities is very limited and is carried on only at the behest of a few dedicated individuals. Their library facilities are woefully inadequate.

The ASI Bulletin, which was started in 1973, therefore serves a useful role in putting together information of astronomical interest and circulating it to ASI members. Of late the Bulletin has also been publishing original research papers.

What are the highlights of the Gorakhpur meeting? One of the most interesting areas in present day astronomy is the study of powerful sources of energy lying outside our galaxy. How powerful are these sources? To put the matter in proper perspective, imagine the energy poured out in the explosion of a 100 megaton H-bomb. The explosions of a few such bombs would be enough to

wipe out life on earth. By comparison, a quasar situated billions of light years away has a storehouse of energy a hundred billion billion billion billion times that of the H-bomb.

A quasar, the exploding nucleus of a galaxy, a strong source of radio waves and the more recently discovered powerful X-ray sources are instances of extragalactic energetic sources. The symposium on high energy astrophysics at the Gorakhpur conference includes discussions of problems faced by theoretical astrophysicists attempting to solve the mystery of where, how and why so much energy is being generated in select regions of the universe.

Five decades ago astronomers were still puzzled about the source of energy which keeps the sun shining. The mystery was solved when it was realised that the central region of the sun is hot enough to trigger off fusion reactions. The nuclear reactions release sufficient energy to keep the sun shining for billions of years. It is the same source of energy that man is (so far unsuccessfully) trying to tap in fusion reactors built on the earth.

Unfortunately, as astronomers are discovering, what is good enough for the sun falls far short of the energy requirements of these extragalactic sources. Some new idea is needed to solve the energy mystery of these sources. Black holes, white holes, are among the various esoteric ideas thought about at present. Esoteric? Well, even fusion reactions were considered esoteric in the 1920s.

Cosmology, the theory of origin, structure and evolution of the universe also features in the Gorakhpur conference. Most astronomers believe that the universe started with a big bang, from a state of very high density and very high temperature. It was the US physicist George Gamow who argued that in the first few minutes after creation the universe was hot enough to act as a thermonuclear reactor in which all the elements were 'cooked'. As the exploded universe continued to expand it cooled down. Gamow predicted that some relic radiation from those early hot moments should have survived to this day. In 1965 such radiation was discovered and the concept of the 'big-bang' universe received a strong boost.

But several points remain to be cleared in this picture. An important issue still to be resolved is the apparent preponderance of matter over antimatter in the universe. Why and when was the symmetry between matter and antimatter broken? Particle physicists have joined forces with cosmologists to answer this question. One conclusion from this line of reasoning is that the proton—the particle in the nucleus of the hydrogen atom—should decay. The proton was hitherto considered as a stable, indestructible particle. Does it really decay? The KGF experiment, the first of its kind in the world, can detect whether a proton can decay in ten thousand billion billion billion years. The experiment, which is reported at the ASI meeting, does suggest that a proton decays. But more observations are needed to confirm so profound a result.