

## INAUGURAL ADDRESS

Y a. B. ZEL'DOVICH

*Institute of Applied Mathematics, USSR Academy of Sciences, Moscow, U.S.S.R.*

Symposium No. 63 as well as all the extraordinary Sessions of International Astronomical Union are dedicated to the 500th anniversary of the birth of Copernicus and we are assembled here in Copernicus' native land. We are paying tribute to the creator of the first scientific cosmological theory.

The need to investigate the Universe is deeply embedded in man's mind and nature. In our twentieth century cosmology has definitely developed as a separate branch of science with its own mass of observational data and theoretical concepts. This branch is closely tied with other branches of astronomy and with physics, but still cosmology has its own features and specific problems.

We are sitting here at a moment which is perhaps a turning point in our science. Several very important problems seem to be definitely settled. I should point to the excellent redshift-magnitude diagram for brightest galaxies. The other discovery is the Planckian spectrum of the so-called relic radiation. Taken together these two pieces of evidence seem to confirm the concept of a Hot Universe.

If here, during our Sessions, no objections will emerge, then we may congratulate ourselves and go further, concentrating on the unsolved problems within a definite framework.

Let me recall some of the unsolved problems without any pretence at completeness or their order of importance.

These problems are:

- (1) the structure of the Universe – the choice between open and closed models.
- (2) the non-uniform distribution of matter and especially the clustering of galaxies.
- (3) the origin of galaxies, their rotation and magnetic fields.

We shall discuss the hypothesis of charge-symmetric Universes in which half of the galaxies consist of antimatter. The role of those observed celestial monsters, – the quasars – and those predicated monsters – black and white holes – must be clarified.

One of the most intriguing questions is that of the initial singularity, i.e. of the situation in the remote past, where theory predicts infinite density, infinite temperature and infinite spacetime curvature. For many decades, the attitude of theoreticians towards this singularity was one of strong dislike to this unwanted child born from the marriage of general relativity with observations (no pills existing at the time of Einstein and Friedmann!). Now many of us are very happy indeed to investigate the implications of all these infinities. Direct observation is out of question on this scale. More important are the links suggested by various theories which tie singularity problems to observable features.

What was the state of the Universe in the remote past? Was it a well ordered expansion with only small departures from strict uniformity and isotropy? Or perhaps

it was strongly turbulent and chaotic, quite different from the picture born 50 years ago on the end of a theoretician's pen and described in the two famous articles by Friedmann in 1922 and 1924? How do we make the choice?

Scientific investigation is based to an equal extent on logic and intuition, on hypothesis and rigorous proof. The picture of the remote past cannot be found by simply solving the equations which describe the evolution backwards in time. The correct procedure is to take definite arbitrarily chosen variants of the initial (as a rule-singular) state and to follow the theory of its evolution up to the present time and hence to confrontation with observations.

There is an obvious objection to this procedure in that it is dependent on individual prejudices, the likes and dislikes of authors, and perhaps even dependent on their subconscious Freudian attitude to such things as order, chaos, antimatter.

But this is why the second phase of investigation – the confrontation with observations – is so important. At this stage false theory fades. The truth, after observational confirmation has been obtained, is made a part of science with its own destiny, independent of the personalities of the authors. Objectively existing truth is selected by observations out of many subjective proposals.

The collective wisdom of the council of the International Astronomical Union should be pointed out: it is expressed in the title of our Symposium 'Confrontation of Cosmological Theories with Observational Data'. Just this confrontation is the clue to the truth!

Once more one should stress the importance of careful trustworthy unprejudiced observations. We tried to allocate time to all the most important aspects of the observations. Theoreticians are asked to stress in their reports the observational implications and the possibility of observational confirmation of their theories. We should remember the motto given by the outstanding Soviet physicist, the late Arzymovich: "There is nothing worse than doubtful theories confirmed by doubtful experiments."

Being a physicist, I was intimidated and almost frightened by the offer of the council of the IAU to take responsibility for this symposium. The working out of the agenda and the distribution of time between different schools of thought, and different scientific approaches, did not go smoothly, and there was much vigorous discussion. The total number of requests for time to present contributions was three times greater than it was possible to include in the final programme. Probably not all our decisions were the best – but I earnestly hope that the participants will correct our blunders during the session and panel discussions.

In order to convey their ideas to their listeners, the rapporteurs must remember that English – which is the official language of our symposium – is the native language for only 35% of the participants. Specific broken English (not Shakespearian or slang) plays the role, played by Latin in the time of Copernicus.

One must speak loudly, slowly and distinctly!

Even more important is the method of presentation. Let me show you on a slide a maxim taken from the 'Forsythe Saga' of John Galsworthy:

“A platitude must be stated with force and clarity.”

Do not be afraid of mentioning first the basic ideas and main points before going into technical details, even if these ideas are well known.

The sessions, discussions and informal gatherings provide an ideal environment for improving the ties between scientists of different countries and different scientific backgrounds. Let our Symposium make its contribution to the noble task of scientific development!

The People's Republic of Poland named the Copernicus anniversary year a 'year of science'. It is a beautiful example, worthy of imitation. I hope that we shall see the nomination of years and decades of science, perhaps even years of astronomy on an international scale with all peoples of Earth involved.

It is a special pleasure for me to open this session by asking for a contribution from a team of Polish astronomers who have contributed so much to the organisation of this symposium. Professor Konrad Rudnicki, one of the co-authors of this first paper, should be specially mentioned in this respect.