

Despite the superb work done by observers, it seems that all efforts to discriminate between the theories by means of large-scale features must still be inconclusive. This seems to apply not only to optical observations but also to radio surveys. At present therefore we must consider less direct evidence.

According to evolutionary theory, galaxies must have been formed from a space-filling gas at a definite stage in the expansion of the universe. But a satisfactory process has not so far been proposed.

The steady-state theory, however, by its very nature cannot pose the problem of an original formation of galaxies. D. W. Sciama has stressed that its problem is the self-perpetuation of the existing population with all its characteristics. He has outlined a remarkable solution of the problem which is as follows.

A galaxy is, in general, in motion through intergalactic gas by virtue of its random velocity. The gas that falls towards it as it passes, forms a wake behind the galaxy, as in the well-known theory of gravitational accretion. The wake material will tend to pull itself together by its self-gravitation and so forms a 'daughter' galaxy. There is a critical condition for the daughter to break away from her parent instead of remaining gravitationally bound. If they separate, the process will start again with each galaxy. If they remain together, the process will be repeated with the pair, and by the production of further offspring a cluster of galaxies of increasing population may result. But a cluster has an inherent tendency to lose members by 'evaporation'; this and other factors hinder its growth indefinitely. The galaxies that evaporate off maintain the distribution of random motions of the field galaxies. The characteristics of this self-perpetuating system depend ultimately upon the properties of the atomic hydrogen which constitutes the bulk of the intergalactic material postulated in the theory. The theory cannot yet be regarded as established but is attractive and has no arbitrary features.

Calculations imply that 90% of all matter is intergalactic and the mean density ρ according to original theory works out to 3×10^{-5} hydrogen atom cm^{-3} . According to the steady-state theory the existing matter moves out of any region as a result of cosmical expansion and is replaced by 'new' matter once in about 2×10^9 years on the average. Thus there is a creation process which must be one involving fundamental particles and producing hydrogen. Consequently at some stage it must yield protons and electrons. Calculations reveal that over a big range of temperature there will be significant fractions of both neutral and ionized hydrogen.

The concept of continual creation has not proved repugnant to current physical theory. It has indeed provoked a further line of speculation. For, 'matter' constituted of positively charged nuclei and negative electrons, and 'anti-matter' constituted of negatively charged nuclei and positive electrons, are treated in symmetric fashion by current theory. In particular, both sorts have theoretically identical inertial and gravitational properties. On general grounds we might therefore expect any creation process to produce statistically equal amounts of matter and anti-matter and the universe in the large to be composed of equal amounts. On the other hand, any particular galaxy must be composed effectively entirely of one sort only. It has even been suggested that some very energetic collisions observed to be occurring in some parts of the universe are between galaxies of opposite compositions.

The steady-state theory has survived for nine years since its announcement. Despite its peculiar vulnerability, no observation has been found to refute it that is not itself of uncertain interpretation. The obstacle regarding nuclear synthesis has disappeared and with it one of the main arguments for the evolutionary theory. The solution of the problem of galaxy formation seems to be within reach of steady-state cosmology, while older theories have not shown much progress towards solving it

HAFKINE INSTITUTE

THE Haffkine Institute, Bombay-12, will be celebrating its Diamond Jubilee from 10th to 14th January 1959.

The celebrations are expected to be inaugurated by the President of the Republic of India. The programmes will include lectures and scientific seminars on topics such as plague, cholera, rabies, influenza, poliomyelitis,

snakes, venoms and insect resistance to insecticides. These will be on international level for participation.

All scientists, scientific organisations and learned societies are invited to attend or to send delegates so as to encourage free flow of research ideas and goodwill between Research Institutions in the world.