

beginning to contribute some tentative calculations of evolutionary rates in various groups, particularly among vertebrate animals; and the establishment wherever possible of invertebrate phylogenies will have rewarding results here as in other fields. The problem of evolutionary mechanism is a purely zoological one, but the ultimate proof or disproof of evolutionary theories involving phylogeny, such as proterogenesis, recapitulation and orthogenesis, also lies fairly within the field of palaeontology.

The major contributions in palaeontology have been made where its limitations have been frankly recognized and its unique assets most fully exploited. These are, of course, the time factor and the historical record of evolution. To bring palaeontological evidence into the evolutionary picture, however, involves a synthesis with genetics, taxonomy and zoology from which is now emerging a new 'science of four-dimensional biology'. In such studies, the emphasis has tended to shift from the individual to the population, with the consequent need for statistical treatment, and successful generalizations will call for accurate quantitative as well as qualitative methods of research; but Prof. Bulman emphasizes in this address the primary importance of the most detailed and exact morphological investigations which contemporary techniques can provide.

MAN AND THE WORLD'S FAUNA

DR. L. HARRISON MATTHEWS, in his presidential address to Section *D* (Zoology), points out that man has continually preyed on the fauna of the world. The increase in the human population and man's technical skills have enabled him to exploit the fauna with ever-increasing destructiveness. It was not until the populations of animals were reduced below the danger point that man realized that they were not inexhaustible. Destruction of particular species has also been due to man's destruction of the environments to which the fauna has been adapted. Human settlement of land and the development of agriculture have caused many animals to be banished from their natural environments.

Man now realizes that breeding fauna in captivity will not alone maintain its existence. He has introduced legislation prohibiting or limiting the killing of certain species and has provided sanctuaries in the form of reserves. It is essential, however, that the conservation be not only applied to the fauna but also to the environments. Basically, it is a problem of land management and development, vital to man as a means of producing energy—food and other useful products.

For the conservation of animals specifically for commercial purposes, Dr. Harrison Matthews gives examples of the recoveries for the fur-seal and the elephant-seal, and how extinction in the Antarctic was prevented by the intervention of the Falkland Islands Government. He also mentions the not so satisfactory history of the whaling industry; the only thing that regulations gained here was to reduce the rate of extermination. In general, the sea-fishing industries of the world present many complications so far as conservation is concerned, especially the question of replacement of the life-giving plankton. On land, over-grazing is often a serious threat to animals; however, some scientists hold the theory

that in some cases artificial control is unnecessary, stating that it is effected by natural causes in the long run.

Dr. Harrison Matthews refers to the population dynamics of certain classes of mammals, and gives an account of the catastrophic 'crash' that invariably arrives after a peak in numbers has been reached, especially in vole-plagues. The over-crowding of the immediate environment that occurs tends to result in psychological tension which eventually causes dysfunction of the adrenal gland; the breakdown of adrenal function causes the rapid death of the animals.

A recent inquiry shows that in 1958 the world population increased by 47 millions; at this rate, in forty years time the human population would double. It is unlikely, however, that this will occur as the growth of the human population tends to become slower and reach a stable level with the increasing standards of living. If we compare the present build-up of population with the cyclic build-up of the population of small mammals, it would seem that we are rapidly approaching the peak and the catastrophic 'crash'. Other factors are also likely to control the growth of population, such as atomic war and its radioactive contamination of the atmosphere, social control by inhibiting fertility in either sex, or the emergence of new epidemic diseases.

Dr. Harrison Matthews points out that the conservation of the world's fauna must be planned on a world-wide scale. It must be decided what parts are to be developed for human occupation and what parts are suitable for conserving fauna; already a number of national and international bodies interested in conservation exist; however, as such there has been only little action. He sums up by advising all zoologists to study any aspects of biology of the larger animals before it is too late.

TRENDS IN URBAN EXPANSION

LARGE-SCALE urban growth, which was a feature of nineteenth-century industrial development in western Europe and eastern North America, is the theme of the presidential address to Section *B* (Geography) by Prof. K. C. Edwards. It has continued to the present day, affecting almost all parts of the inhabited world. Recent decades, however, have witnessed a sharp acceleration of the process and urban expansion is now going on at an unprecedented rate. While industrialization remains a primary factor, it has come to play a relatively less important part in the crowding of people into cities.

Owing to the lack of a common definition among different countries as to what constitutes an urban population, precise measurement of the rate of urban growth for the world as a whole is impracticable. Some idea of its magnitude over the past half-century so far as large towns are concerned, that is, those of 100,000 inhabitants or more, can be obtained from the figures in Table 1.

Table 1

	No. of towns of 100,000 inhab. or more	Size groups (population in thousands)				
		100-250	250-500	500-750	750-1,000	More than 1 million
1910-13	322	200	63	33	8	18
1950-53	1,071	611	299	67	32	62