

## GENERAL DISCUSSION

The following discussion was contributed either after the paper on computer analysis (later rewritten with new data as Part III) or in general discussion. These contributions are placed here because they discuss general principles. They were placed here and thus taken out of their context in the meeting when it became clear that a complete record of the discussion was impracticable.

Professor F. W. SHOTTON noted that the smoothed curve presented by Funnell & Cutbill that showed the rate of diversification had a marked bend around the Trias, with the implication that after that time diversification had proceeded at a reduced rate. The time-scale had been constructed on the basis of a unit of time for each stage and he wondered if the use of a radiometric scale of time would accentuate or diminish or even eliminate this apparent difference of behaviour in the earlier and later Phanerozoic.

Dr D. V. AGER welcomed the interesting study by Funnell and Cutbill of the psychology of palaeontologists. He was particularly struck by the bimodal distribution demonstrated by them for all invertebrates, and the way this contrasted with the more even curve for the vertebrates. The speaker suggested that this reflected nothing more than the nature of the fossil record in the U.S.A., with its diversity of forms in the Palaeozoic and Tertiary, but great deficiency of marine facies and faunas in the Mesozoic. He did not think it had any world-wide significance.

It had been suggested that the family categories he used in the analysis of the fossil record were in some way less subjective than genera. This he did not believe. If one considered the particular group—the Rhynchonellacea—with which he was most familiar, taxonomic record and the actual record were completely at variance with each other at all levels.

The taxonomic record of families gave two large peaks, like those for the invertebrates as a whole, one in the middle to late Palaeozoic, the other in the Tertiary. These showed little if any relevance to the realities of rhynchonellid diversity and abundance, and resulted entirely from the work of two specialists who had proposed 14 out of the 19 relevant family names. Similarly, the much discussed 'evo-

lutionary burst' in mid-Ordovician times was also clearly seen in the taxonomic record of the rhynchonellids, but resulted from a single publication.

In fact, most specialists would agree that the rhynchonellids arose as very minor elements in the Ordovician brachiopod faunas and only very slowly increased in numbers and in diversity through Palaeozoic times. Their only 'sudden' evolutionary burst came at the end of Frasnian times, when they seem to have made a 'take-over bid' for the ecological niches previously occupied by the atrypids. This is seen in Canada, Belgium, Germany and Australia, but makes no showing in the taxonomic record at family or even generic level. The rhynchonellids were apparently unaffected by the end of the Palaeozoic; and the supposed contrast between Palaeozoic and Mesozoic faunas results partly from our lack of knowledge of Lower and Middle Triassic representatives, and partly from the differences in approach, classification, terminology and prejudice of Palaeozoic and Mesozoic workers. The rhynchonellids in fact came out of this gap in the record very much as they went into it, and continued their progressive diversification. In later Mesozoic times they seem to have suffered a gradual eclipse by the Terebratuloidea and from those benthonic molluscs which took over from both.

The beginning of the Tertiary Era saw a marked diminution in the abundance, diversity and distribution of the rhynchonellids, at least in the most-studied parts of the world. This is in marked contrast to the further diversification suggested by the mere list of family names available. The truth is probably somewhere between the two, but nearer the first, for in the right facies the Tertiary rhynchonellids do seem to continue the Mesozoic story down to the present day.

Summing up, it may be said that the main

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events in the history of the rhynchonellids—their gradual increase and decline, their spurt in the Famennian and their slump in the Palaeogene—are not shown up by any counting of taxonomic heads.

On the basis of this sort of observation, Dr Ager did not think that *The Fossil Record* should be taken too seriously or used as a basis for idle theorizing.

In connexion with the diversity of the taxonomic record in relation to epirogenic seas Dr Ager remarked that this probably reflected the concentration of taxonomic palaeontologists rather than the extent of the epirogenic seas.

Dr V. G. WALMSLEY pointed out that the estimate of the average duration of Lower Palaeozoic stages as 15 to 30 m.y. each could be somewhat misleading for the late Silurian. According to the figure given in *The Phanerozoic Time-scale* the total duration of Silurian time appeared to be 20 or 40 m.y. depending on whose figures were accepted. What proportion of Silurian time was attributable to the Ludlovian was arguable but on the basis of graptolite evolution, one quarter was probably the right order of magnitude. This meant allowing 5 to 10 m.y.

for the Ludlovian of which the four stages would on average seem to have lasted  $1\frac{1}{4}$  or  $2\frac{1}{2}$  m.y. each. This estimate was considerably less than the average figures suggested.

Mr N. F. HUGHES said that in constructing the stratigraphical scale, the committee took note of Dr Walmsley's difficulty and avoided the use of the term 'stage' [see column 2 of Table 1, Introduction].

Dr R. A. CROWSON said that no speaker at this symposium had given a reasonable explanation of extinction of anything. Professor Sylvester-Bradley's suggestion of tabulating origins, extinctions, etc., of taxa against a time-scale in years is rather like making a table of establishment or extinction of status, governments, languages, industries, etc., against centuries—a procedure whose value he doubted for the understanding of human history.

Dr J. M. HANCOCK emphasized a point already made by several speakers: the appearance and disappearance of different taxa is only one aspect of the relative success of different animals. Human beings are one of the most successful animals living to-day, but they are only one species in a table.