fact to be a true tetrapod humerus.

Other resemblances to the anatomy of early tetrapods are also confirmed. *Eusthenopteron* has two-headed dorsal ribs, albeit with very little blade, throughout the trunk. Furthermore, the pelvic girdle probably had a ligamentous attachment to the vertebral column in the sacral region. This condition would be the expected forerunner of the tetrapod sacrum with a bone-to-bone articulation of the girdle to one or more pairs of specialized sacral ribs.

The most interesting differences between the postcranial skeleton of *Eusthenopteron* and those of other rhipidistians, described in the second article, concern the structure of the vertebrae. The vertebrae of *Eusthenopteron*, inadequately described before this account, have been cited in the decades since the war as the ideal forerunners of the tetrapod condition. The other rhipidistians, however, have a bewildering variety of vertebral types, and as more becomes known of the condition in very early, pre-Coal Measure tetrapods the orthodox theory of vertebral evolution in early land vertebrates becomes more and more unsatisfactory.

Description of the skeletons of rhipidistians other than *Eusthenopteron* also allows a more rational classification within the group and one is presented by Andrews and Westoll. These two articles are a remarkable achievement and will long remain an essential source of information for students of vertebrate evolution.

CONTINENTAL DRIFT

Initiation of Rifting

from our Structural Biology Correspondent

KNOWLEDGE of the timing of the opening of the Atlantic Ocean and of the mechanism involved is extremely hard to come by. The lack of clear magnetic anomaly patterns in the "quiet" magnetic zone on both sides of the Atlantic floor has required an extrapolation backwards of spreading rates from the well established younger central zone of the Atlantic in order to gain approximate dates for the opening. This method gives a wide range of dates for the commencement of opening from Late Permian onwards, depending on the spreading rate favoured.

Another method which has been fairly successfully used has been to determine two sets of magnetic pole positions from continental rocks to either side of the Atlantic during successive stages of Earth history from the Carboniferous onwards. By rotating one of these sets of poles by the equivalent of the amount required to close the Atlantic, it is possible to see at what stage the two sets of pole positions fail to coincide, thus giving the first point of Atlantic spreading. Larson and La Fontain (*Earth Planet. Sci. Lett.*, **8**, 341; 1971) found by this method that the Atlantic started to open at the close of the Triassic.

On purely geological reasoning, Hallam (*J. Geol.*, **79**, 129; 1971) suggests that spreading started during Lower to Middle Jurassic at the time of the breakdown to a deeper water environment of the widespread and long-lived carbonate platform of the Mediterranean region. He further suggests that downwarping of the southern North Atlantic borders with associated faulting and volcanic activity during the Upper Triassic indicates a period of rifting occurring some 50 million years before the actual separation of the continents. This model is in good accord with a Rift Valley/Red Sea pattern of oceanic opening.

Further corroboration of Hallam's initial tensional phase before spreading has recently been supplied by May (*Bull. Geol. Soc. Amer.*, **82**, 1285; 1971). He has found that Late Triassic doleritic dyke swarms in eastern North America, West Africa and north-eastern South America fall into a regular radiating pattern if these continents are restored to their relative pre-drift positions (essentially according to the Dietz *et al.* reconstruction (*Bull. Geol. Soc. Amer.*, **81**, 1915; 1970). The pattern is roughly convergent on the Blake plateau, the Bahama platform and the western Senegal basin, and individually the dykes bear no particular relationship to the structures of the continental rocks through which they intrude. It thus seems that the stress field responsible for the dyke intrusions was unrelated to continental crust tectonics but rather, as the dolerites themselves are of typical oceanic composition, to activity within the upper mantle.

May is able to show that the intrusion of the dykes was related to a tensional

The Extent of Reverse Transcription

IT is hard to believe that the chief role of reverse transcriptase in tumour viruses is something other than the synthesis of a double stranded DNA provirus as Temin has proposed. And Duesberg and Canaani have already reported, as expected, that the reverse transcriptase in Rous sarcoma virus transcribes *in vitro* all the sequences present in the viral RNA genome, albeit as a series of small DNA molecules rather than a single DNA molecule as big as the viral genome. In next Wednesday's *Nature New Biology*, however, Varmus, Levinson and Bishop describe a more detailed analysis of the products of reverse transcription of Rous sarcoma RNA which suggests that at least *in vitro* some sequences of the viral genome are preferentially transcribed into double stranded DNA.

Reverse transcription takes place in two steps; the first is the synthesis of a single DNA strand complementary to the viral RNA genome to yield a RNA.DNA hybrid; the second involves the synthesis of a double stranded DNA using this hybrid as template. When Duesberg and Canaani measured the extent of transcription *in vitro* of Rous sarcoma virus RNA they hybridized the total DNA made, both single and double stranded, to viral RNA.

What Varmus *et al.* have now done is measure the extent of reverse transcription *in vitro* into double stranded DNA. After separating the single stranded from double stranded DNA made by Rous sarcoma virus reverse transcriptase they measured the rates of reassociation, after denaturation, of the double stranded product. Most of this DNA rapidly reassociated, a small proportion slowly reassociated and some failed to reassociate. By making various assumptions Varmus *et al.* estimated the molecular weight of the rapidly reassociating fraction and what fraction of the total Rous sarcoma genome it corresponds to. They claim that from 85–90 per cent of the double stranded DNA is probably transcribed from about only 5 per cent of the viral genome assuming its molecular weight to be 10×10^6.

But does the slowly reassociating fraction of the double stranded DNA contain sequences corresponding to the entire viral genome? Varmus *et al.* claim, from measurements of the rate at which it reassociates, that this double stranded DNA corresponds to only about 20 per cent, rather than 100 per cent of the genome. Moreover, they report experiments which they interpret as showing that at least 30 per cent of the DNA sequences found in RNA.DNA hybrids are not transcribed further into detectable amounts of double stranded DNA. They mention, however, unpublished experiments of Martin and his colleagues who apparently also find a major rapidly reassociating fraction and a smaller slowly reassociating fraction of double stranded product but who believe the smaller population of molecules include all the sequences of the complete viral genome. It is perhaps too early to decide which interpretation is correct, but it seems clear that a small part of the viral genome is transcribed *in vitro* into double stranded DNA much more often than into the complete genome.

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