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The facts and fictions of the Oceanic Tethys concept

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Abstract

Tethys is believed to be a wide ocean which closed, reopened, and then closed again, and referred as Proto-Tethys, Paleo-Tethys, Neo-Tethys and Para-Tethys subducting some 5000 km of oceanic crust before disappearing completely. Tethys Ocean continued to expand dividing Pangaea into the two large continents of Laurasia in the north and Gondwana in the south, creating an oceanic extension, which today forms the Central Atlantic Ocean. Suess's Tethys connecting eastern and southern Asia with Middle East and Europe through the Himalayas persisted from mid-Permian (250 Ma) and vanished in the Paleocene (50 Ma). It was an epicontinental Sea, transgressed and regressed frequently, covering northern India to southern Siberia and from the present Pacific coastal area to perhaps Italy, in its former position besides Spain. It apparently continued into the Appalachian geo-syncline and through it extended from

eastern to western Panthalassa Sea –precursor to the modern Pacific Ocean. It was thus, a truly intra-Pangaea Sea.

This paleontological, paleoclimate and Paleogeographic evidences do not support the existence of the Proto-Tethys, Paleo-Tethys and Neo-Tethys. Indeed, India was continuous with the rest of Asia, and therefore it could not have collided with it. The Himalaya is an inter-platform type of mountain range formed by vertical uplift and gravity gliding and not by continent-continent collision as believed today. Rejection of a vast Tethyan Ocean, the apparent small size of an Arctic Ocean and the questionable validity of vast Pacific Ocean lend support to concept of expanding Earth. Although, objections are raised against Earth expansion, but if there was no Tethyan Ocean, and if the Arctic Ocean was smaller than now, the Earth should have been deformed and smaller.

Keywords: Tethys, Expanding Earth, Himalaya

1. Introduction

Eduard Suess (1983) introduced the term Oceanic Tethys for a seaway connecting eastern and southern Asia with the Middle East and Europe through the Himalayas. Since then it has dominated geological scene and has been referred frequently without clear definition of its spread in space and time. Further the global plate tectonics hypothesis added confusion because an ocean north of India is needed in this concept. Suess considered there was a land mass in the north as Angaraland and to the south a land mass which he called Gondwanaland. During the Asselian (lowermost Permian) and perhaps during early Sakmarian, there was apparently no seaway across Southeast Asia. At this time, the Central Asian Sea still connected eastern Asia with the Middle East and Europe through China. This connection was broken perhaps by the end of the Sakmarian and at no later time up to the present did Sea penetrate through this region. This time of the Central Asian Sea in the Permian, which contained warm water faunas, coincides with the time of the extensive glaciations in Gondwanaland (Metcalfe, 2001).

The concept of hypothetical Sea is based fundamentally on the then apparently established floral differences between Europe and America on the one hand and Gondwanaland, on the other. Du

Toit (1937) suggested that in the late Paleozoic an oceanic Tethys separated Gondwanaland from Laurasia, Angaraland and Cathaysia. This was later modified to a triangular gulf, during near the Black Sea or farther west, when Pangaea was resurrected. The great wedge-shaped ocean that gaped eastward between Laurasia and Gondwanaland, though still widely favored (Tollmann and Kristin- Tollmann, 1985; Metcalfe, 2013) seems to be discredited by detailed geology, and faunal distribution. On the other hand, by Middle Permian the faunas of the Himalaya and Tibet are so similar or even identical at the generic and specific level (Dickins et al., 1993) with those surrounding regions that the wide Tethyan gulf of many reconstructions (e.g. Scotese and MeKerrow, 1990) hardly seems possible. Many workers have pointed to evidence against such a wide gulf and indicated that it was not based on geological data but perhaps resulted from fitting South America and South Africa thus either pulling all of Asia down to the south or making some arbitrary split to form a wide eastward facing Tethyan gulf. Thus, how a vast ocean shown in the Carboniferous could have disappeared virtually without trace by Middle Permian or how during the Upper Permian a Paleo-Tethys was filled and a Neo-Tethys formed by the movement of 'Cimmerian' from Gondwanaland to Angaraland during Upper Permian to Triassic without substantial evidence is a puzzle. In addition, it if difficult to believe that the Faunas could have migrated during Upper Carboniferous and Lower Permian through such circuitous routes with large difference in latitude, when a simple direct route would have been available in the absence of a wide Tethyan gulf. Detailed field studies in the Tibet and Karakorum suggested that sediments of the supposed southerly and northerly shores were related and did not far apart and statistical studies of faunal distribution affirmed it (Waterhouse and Bonham Carter, 1975; Li Xing-Xue et al., 1985). The Indus-Yarlung-Zhangbo suture does not mark a vast Permian sea-way or ocean, now closed. Moreover, faunal distributions have established that the Permian equatorial belt passed from the Mediterranean eastwards through Fergana and south China. These lay close to a Permian latitude of 0^{o}, not, as supposed by the great wedge-shaped ocean theory, at Permian latitude of 40^{o} N, or more. Placing these regions in their true position leaves no room and provides no evidence for a vast Tethyan ocean in Permian times. Carey (1976) had demonstrated that this 'gulf' was an artifact and would be closed of the Earth was of a smaller diameter.

The present paper argue the concept of the Proto-Tethys, Paleo-Tethys and Neo-Tethys in light of geological, paleontological (vertebrate, invertebrate and insects), paleoclimatic and paleogeography evidences. Comments are also made on the continuity of India with the rest of Asia.

2. The Basis of the Two Continents

Wegner (1929) was of the opinion that there was one continent on the Earth, Pangaea, surrounded by an ocean, Panthalassa, but accepted Gondwanaland in the Paleozoic times. It was Du Toit (1937) who precisely defined the concept of two continents; Laurasia and Gondwanaland, separated by the Tethys, and this concept have gained ready acceptance in all subsequent discussions about Gondwanaland, and considered it as a separate entity. Thus, Dietz and Holden (1970), Scotese and MeKerrow (1990) and many other reconstructions retains it, was also the plate tectonics largely depended upon it in the conceptual model that the Himalayas have been formed as a result of collision of the two landmasses, Gondwanaland and Angaraland (see: Valdiya, 2015, for references therein) with or without over-riding and under-thrusting of one landmass over the other.

Du Toit, like Wegner, had convinced heavily on the evidence that glacial deposits, indicating frigid climate, known from all the continents comprising Gondwanaland, in comparison with the warm, dry climate known to have prevailed over the northern continents. In view of the altogether different flora in the two regions, the Permian period saw several supposedly well defined floral provinces as [1] the Gondwana, [2] the Cathaysian, [3] the Angara, and [4] the Euramerican, each characterized by its own typical flora. Thus, the *Gangamopteris-Glossopteris* flora was believed to be characteristic of Gondwanaland and any other intruder from the northern continents was explained by accidental transport, parallel evolution or by homoplasy. Also, it was noted that certain invertebrates, e.g. *Eurydesma and Conularia*, appeared to be strictly confined to the Gondwanaland continents.

This was perhaps justified by considering a wide sea, the so-called Tethys, in between the two continents, albeit the difficulties the two- continent concept encountered in explaining the singular similarities in Triassic vertebrate faunas of South Africa and Russia. However, in recent years the myth of this biological contrast has been finally exploded by a series of discoveries of floral and faunal elements, particularly of vertebrates, insects, identical or closely similar to those known from the Gondwanaland or the northern landmasses. Simultaneously, paleomagnetic evidence has confirmed that polar wandering was feasible which could explain the difference in the climate, with South Pole wandering across Gondwanaland in the Paleozoic (Ahmad, 1988) and the North Pole transgressing into northeast Siberia in the Late Paleozoic.

3. Paleontological Arguments

Recent years have witnessed new data which imply that not only flora and micro-flora, but even invertebrates and vertebrates had no constraints in their migrations. It resulted in regular two-way traffic, perhaps limited only by thermophylic and hydrophilic controls and suitability of environments. The story of the Tethys can, therefore, best be started with paleontological elements common to Gondwanaland and one or more of the supposed northern landmasses, Laurasia, Angaraland and Cathaysia.

3.1. Distribution of Plants

Only few decades ago *Gangamopteris-Glossopteris* flora was thought to be strictly confined to Gondwanaland. However, of late elements of this flora have been reported from north-east Siberia (Meyen, 1969), Thailand, China and Korea (Asama, 1969), southern Tibet (Hsu, 1976), Karakoram Tethys Zone (Upadhyay et al., 1999). Ahmad (1983) reviewed the paleontological evidence bearing on the subject, and concluded that of the plants *Gangamopteris*, *Glossopteris*, *Schizoneura*, *Vertebraria* etc. were common to the Gondwanaland, and the northern landmasses, Laurasia, Angaraland and Cathaysia, some occurring more or less simultaneously. Indeed, considered as a whole, this flora distribution indicates a significant similarity of ecological conditions and suggests actual contiguity of the land areas. What appears to be of the utmost importance is that the traffic was certainly in both the directions, plant believed to have been characteristically of northern origin migrating into the southern continents, and the supposed typical Gondwanaland plants migration into the northern landmasses, and successive geological ages across the oceanic Tethys. Long ago, Just (1952) has concluded that the Gondwana flora had been in contact with the Angara flora in Kashmir, with the Euramerican flora in South Rhodesia, Mozambique and Malagasy, and with the Cathaysian flora in New Guinea, accordingly he suggest that these contact could not have been isolated or accidental. Mixed floras are now also known from South Africa and Argentina. The discovery of the mixed floras at Hazro in Turkey is quite interesting, for Turkey was in the centre of Pangaea and not far from any of these floral ‘provinces’. Ahmad (1983) concluded that the presence of northern taxas together with *Glossoperidale*, in certain areas of Gondwanaland now be accepted as a fact.

Significantly, a mixed Gondwana flora have been reported from the Himalayas in the Almora district of Uttaranchal, well north of the Main Boundary Fault, an area that was supposed to belong to the northern landmass, and plant fossils characteristics of the Jurassic of Peninsular India were discovered in Ladakh, from the north of the so-called Indus Suture Zone (Sharma et al., 1980) whereas Barale et al., (1978) have reported them from the Thakkhola valley in Nepal (see also: Dhital, 2015). Tapponnier et al.,(1981) and recently Zhao Zhongbao (2015), admit that Lhasa belonged to Gondwanaland, and earlier views that Gondwanaland in Tibet had been underthrust below Angaraland (Zhao and Morgan, 1987; Sinha, 2002) or that the Indus-Tsangpo line marked the ‘suture zone’ of the northern and southern landmass were untenable.

Whereas these Gondwana genera appeared in Gondwanaland at the very beginning of the Permian or perhaps in the latest Carboniferous, seems to have reached the northern landmasses in the Late Permian. In the opposite direction, the northern types of plants seem to indicate a slightly older age when found in the Gondwana assemblages. The *Sigillaria* present in the southern hemisphere in Early carboniferous does not appear in the northern hemisphere until the Permian. This clear suggest that migration in the two directions was not possible, but had been common. With regards to spores, Archangelsky and Arrondo (1969, p. 77) and Archangelsky (1990) pointed out that thirteen taxas of spores were common between China and Bolivia in the Lower Permian. Such an admixture of two floras developed on separate landmasses needs geographic proximity and one cannot but agree with these authors when they state that ‘admixture of Angara and Gondwana elements has already been accepted and that means migration’. Banks (1972) has drawn attention of spores from the Devonian of Canada being similar to those from the Western Australia, South America as well as Laurasia, which, in turn, were found related to those of Africa and USSR. The same is true of Triassic form having been common to the northern and southern continents and Kerp et al., (2006) has stated that Triassic *Dicroidium* seed fern occurred in northern continents now being reported from a number of localities in southern hemisphere. On the contrary, Permian and Triassic spores known from Europe were entirely different from those that existed at the time in Siberia, China and India and this would indicate that the two areas were separated by a wide sea-way.

Such floral and microspores distribution cannot be fortuitous and negate the long established concept of a wide oceanic Tethys, or even the restricted paleo-Tethys. And, there appears to be no escape from the conclusion that either Pangaea existed as a single landmass or else the Pacific was considerably narrower than today.

3.2. Faunal Evidence

3.2. 1. Marine Invertebrates

It would be appropriate to look from the Cambrian when trilobites were of particular importance. They had their habitat in clayey, silty or muddy flats, and did not cross the oceanic area. Thus, it was believed that the trilobites' fauna of the northern continents was distinct from that of the southern continents, and explained by there being two landmasses, Laurasia and Gondwanaland. Accordingly, *Redlichia* was characteristic of Gondwanaland and *Paradoxides* of Laurasia and are typical of a stable shelf and shallow waters. Chang (1987) suggested that *Redlichiids* originated in Southwest China, and migrated southward, westward, northward and northeastward to Australia, Antarctica, southern Asia, the Mediterranean region, south Siberia and Korea, together comprise *Redlichia* Province. Of late it has been confirmed that in the Lower Cambrian the former existed all along the western Pacific coast of Asia, to China, Manchuria and Siberia, and more important, was simultaneously present in India and Europe (Sdzuy, 1967, p. 6) and in the Middle and Upper Cambrian it has reached Australia, Korea whereas *Paradoxides* have been reported from Gondwanaland. More important was the distribution of *Neoredlichia* and that the closely related trilobites existed in Europe, Siberia, China and Australia, all being confirmatory of free communication between these areas. Barrett (1974) considered the occurrence of an Australian species in South China as embarrassing for those who believed in a separate Gondwanaland at the time, but not for those who accepted a single landmass with an epicontinental Tethys in Cambrian and till atleast the Triassic.

In the Ordovician, the cephalopod, *Ethinoceras* has been reported from Western Australia and North America. Similarly *Manchuroceras* existed in Tasmania, Kashmir and Manchuria, whereas Arenigian trilobites of Argentina, South China and New Zealand belonged to the Euramerican affinities (Ahmad, 1983) whereas the early Ordovician faunas of the southern landmasses in general belong to European and American regimen. It needs hardly to be emphasized that cephalopods needed a continental ligation for migration and deep seas cut off their movement completely.

In the Silurian the brachiopod *Pentamerus, Lingula, Attrrypa* and *Eocoelia* were cosmopolitans in its distribution (Fortey and Cocks, 1998) and latter occurring in South America and Siberia. Similarly, Silurian corals and graptolites appear to have been largely cosmopolitans with link especially between Australia and East Asia (Lin and Webby, 1989) and listed many species of graptolites that are common to America and Australia.

In the Devonian, the relationship appears to have been closer between Gondwanaland and Europe and affinities in the two faunas are clearly discernible. Thus, *Stringocephalus,* a large brachiopod, *Calceola*, a coral and the goniatite fauna and conodonts faunas of Australia completely match those from West Germany and India (Chang, 1987; Burrett et al., 1990; Nicolle and Metcalfe, 1998). Gupta (1976) opined that conodonts of different horizons in the Himalayas have affinities with those in Europe. The Ordovician fauna, including particularly the trilobites, echinoderms, and mollusks studied by Dean (1975) and Metcalfe (1988) leads to similar conclusions. Thus, the paleontological evidence mentioned above, the wide Tethyan Ocean did not exist in the Early Paleozoic. It may have a narrow geosynclinals belt situated between Russian and China platforms and Gondwanaland during the Cambrian and Ordovician times. Further, in the Carboniferous numerous forms of ammonoids, brachiopods, conodonts etc. were common between Europe and Australia (Metcalfe, 2001), and the distribution of *Berichoceras, Prolocanites, Cravenoceras* etc. would have been impossible to explain unless sea in between was epeiric. The common brachiopods with *Syringothyris, Echinoconchus, Eocoelia*, *Virginia* etc. having been recorded from Europe, North America, Siberia and Gondwanaland. How is this distribution to be explained with oceanic Tethys intervening between the two areas?

Certain Permian faunal elements of Gondwanaland were considered to have been strictly endemic, so that their distributions support continental drift, *e.g*. the *Eurydesma-Conularia* fauna of India, Australia, Africa and South America. Yet, it is now considered that the distribution of *Eurydesma-Conularia* was restricted of glacial deposits (Waterhouse, 1987; Dickins, 2001) and, indeed they have been lately reported from China, along with other genera, also similarly considered to have been endemic to Gondwanaland. It may be relevant to point out that the apparently restricted distribution of *Eurydesma* and *Conularia* really be temperature controlled, for all their known occurrences are in glacial deposits. Their endemicity is apparent and of late, they have been reported from northeast Siberia and western China. The North Pole of the time was in Siberia and glacial deposits are known from several areas in the region, providing a suitable habitat for these genera. However, Shi et al., (1996) thought that the affinities of the western China brachiopods fauna are entirely with the Uralian, Western Australia, India, Tibet, Oman, Central Asia, and North America and is indeed also in Argentina. (Teichert, 1971) pointed out that ten genera of Western Australia ammonoids are all of typical Uralian-Tethyan affinities. Thus, *Uraloceras* and *Neocrinites* suggest European affinities, later on, with warmer climates prevailing in the Upper Permian time's corals with Uralian affinities came to Western Australia. Similarly, Shirley (1974) and Dickins (2001) has drawn attention to the Permian *fusulinids* of Australia has a Tethyan distribution, but also occur along the Pacific coast from New Zealand to Japan and North America. In their Permian Jaccard and Simpson similarity coefficient studies on all available distribution data for brachiopods, Talent et al., (1987, figs 2-3) pleaded for plate tectonics concept without considering the possibility that the continents may not be separated from each other i.e. there was but one continent at the time, and not a hotch potch of the various continental fragments and island-arc complexes in Asia. However, no explanation is given how so many forms of life tended to become widely distributed, and even those that they at moment considered as endemic, local or provincial may turn out to be cosmopolitan. Their well documented study is, thus, based on simple statistical jugglery.

The Triassic was a period of general emergence all over Gondwanaland, and localities known for marine faunal remains are limited to Malagasy, the Salt Range, Kashmir-Spiti areas of India and the Perth Basin in Australia. But the trend in cosmopolitanism is persistent, for *Ophiceras, Tropites, Trachyceras, Halorites* etc. are just a few of the genera that were present in Gondwanaland, Siberia, Canada, and even Greenland. They were typically coast bound and how did they manage to spread so far and wide? Similarly, Westermann (1973) has pointed out that the lamellibranches *Monotis and Palaeomutela* has a circum-Pacific distribution, and also had a link in the Tethys. These and other genera also occur in Myanmar, Sri Lanka and South America.

Also there are similarities in the coal litho-types from the Indian coal seams with those in the U.S.S.R and Australian. Veevers et al., (1996) compared the coal properties in terms of maceral group from the Collie (Australia) with Son-Mahanadi; Pench-Kanhan and Godavari valley basins (India) are virtually same. In the Collie, Pench-Kanhan and Son-Mahanadi, Godavari valley basins, vitrinite + inertinite are greater than 70%, exinite lass than 30 %. We interpret the gross similarity in organic matter type and abundance between Indian and Australian coals possibly reflecting similar paleo-climatic, floral, faunal and sedimentary-tectonic set-up. This is consistent with the view that Australia and India were in close proximity during Permian time. Recently, Tewari and Khan (2015) applied Markov chain model to the banded structure and coal litho-types in coal seam of East Bokaro sub-basin, India and concluded that the order of superposition of litho-types is similar to those described from Australian and European coal seams. One cannot thus, over-emphasize the point that non-marine faunas could not have migrated, neither actively or passively, across the oceanic Tethys of the envisaged depth and salinity, if it really and virtually existed.

With such a wide distribution of marine faunas from Cambrian to the Triassic, with numerous biota's being common to the northern and the southern landmasses, including some of the forms that certainly needed a continental ligation for migration, it is surprising that a separate and independent Gondwanaland concept was so nursed for so many decades. Thus it appears that independent Gondwanaland was untenable and that there was distinct land connection between Cathaysian and Angaraland landmasses, subject to the restriction imposed by environmental factors.

3.2.2. Freshwater Fauna and Insects

Even more up-setting of the oceanic Tethys is the distribution of freshwater fauna and insects, for, if the northern and southern continents were separated by a wide ocean, they could have no means of crossing over even narrow epicontinental seas, some could not even come within the tidal range. Their very occurrence on various continents simultaneously would be a complete negation on the concept of isolation. Tasch (1987) and Ghosh and Dutta (1996) reviewed the distribution of conchostracans- a group of arthropods and insects and outlined numerous similarities between the Gondwana, the European and the Angara forms. Accordingly Conchostraca are cosmopolitan in geographic distribution and had habitat in shallow freshwater pools and eggs having intolerance to seawater, thereby has immense importance to the terrestrial biography, specifically for Paleozoic-Mesozoic periods, when their distribution is considered to have been throughout the globe through land routes. Tasch (1987) pointed out that the *Mayfly nymphs* from Antarctica are similar to those of the Jurassic beds of Asia and Siberia, and a

Triassic odonate (*Triassothemis mendozensis*), and relatives in Jurassic beds of Asia and Europe. On the other hand Ghosh and Dutta (1996) recorded the occurrence of *Leaiids* fauna comprises genera Leaia *(hemicycloleaia); Leaia (cycloleaia), Monoleaia,and Rostroleaia* from the Pali Formation of Sohagpur Gondwana sub-basin in India and they are restricted to the Paleozoic rocks of the world. Though this family originated in southern China in Devonian and dominated during Late Paleozoic in Angaraland, attained maximum population during the Permian in Europe, Canada and America in the Northern continents as well as in Gondwanaland during Late Permian i.e. in Australia, South Africa, Antarctica, South America and India. Tasch (1987) concluded that a north-south migration of terrestrial life forms between Gondwanaland and Angaraland during Late Permian through Early Triassic has got too accepted. He even thought that there was direct connection between Australia and China and this is not possible on commonly accepted reconstructions of Pangaea with an oceanic Tethys (Proto-Tethys ocean) widening progressively eastward to the Black sea region to over 6000 km along the Pacific coastal area. Riek (1971) noted that the Upper Permian Australian insect fauna is closely comparable to that of Angaraland, and the contact improved progressively in the Mesozoic. Thus, the arrival of the blattoid and orthopteroids orders in Australia bespeaks of distinct land connection in the Mesozoic. Tasch (1987) suggested routes of migration (Fig.1); all cross the Himalaya where the Tethys, according to popular reconstructions, should have been widest. Mu En-Zhi et al., (1986) on the basis of Permian bio-facies and lithofacies concluded that there was a fair possibility of an extensive continental block extending from the northern edge of present day Peninsular India to southern Asia.

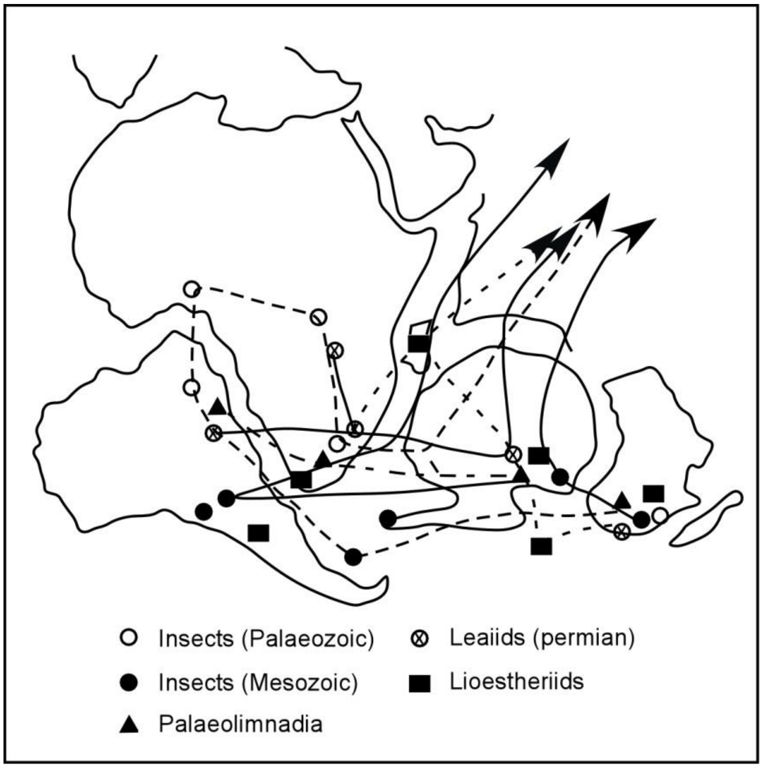

Figure 1.Migration routes of Paleozoic and Mesozoic insects, and fresh water conchostracans. (after, Tasch, 1987)

3.2.3. Vertebrates

An enigma had been the close similarity between Triassic vertebrates of South Africa and U.S.S.R had been recognized for a long time, with no escape from accepting whole-sale migration, and a circuitous route, via Spain or Afghanistan was suggested. Romer (1973) suggested a direct connection between South Africa and Asia in the Early Triassic and free communication with other continents were distinctly indicated. In this context, the presence of the remains of *thecodonts, therapsids, cynodonts, Proterosuchians, saurichia* and many more in the Triassic beds of U.S.S.R and South Africa appear to be impossible to explain without accepting direct land connections. Not only is migration implied but the routes had to be freely traversable without topographic or ecological barriers such as mountains, desert, hot or cold zones, nor deep rivers or sea channels. Romer (1973) admitted that vertebrate faunal interchanges between Eurasia and Africa were at various times could not be considered accidental. Discoveries of reptiles remains during the last three decades have moreover, changed the entire scenario on the distribution of landmasses and oceanic deeps – even of epeiric seas – for bizarre forms like the *Kannemeyeria* and *Cynognathus* from Shansi and Sinkiang area of China possibly have migrated across an oceanic Tethys to appear in Argentina and India. The former (*Kannemeyeria*) has been reported also from U.S.S.R, besides southwest Africa, and perhaps even North America. But what has really been surprising is the discovery of numerous specimens of reptiles of South African Lystrosaurus Zone, including *Proterosuchus, Erythrosuchus* and *Lystrosaurus* itself in China and Indo-China and U.S.S.R as well. Romer (1973, p.473) reiterated that except for the non-appearance of *Phytosaurus* in South Africa and South America, there is no marked contrasts in the reptile faunas of Gondwanaland and Laurasia. The evidence is therefore refute the oceanic Tethys concept. Similarly, the abundance of Triassic *Nothosaurs* in Europe, North America, India, Japan, and China is most remarkable. They were land-based but made occasional forays in sea, however, oceanic deep were impossible for them to manage. More significant is the case of *Phytosaurus*, and particularly *Archosaurs* because they were semi-aquatic and had the ecological niche of crocodiles i.e. by and large they lived in fresh water rivers and lakes. Yet they were present in South Africa, India, Central Asia, Russia and Western Europe. Of similar importance is *Tritylodon,* a genus extreme close to *Archosaurus***,** have been found in Argentina, Western China and Western America. These discoveries led Colbert (1979) and Bandyopadhyay (1999) to conclude that 'perhaps Gondwanaland was somewhat less isolated from Laurasia in Late Triassic time than it had been in the previous phases of Triassic'. Recently Cisneros et al., (2015) has summarized the situation that *tetrapods* group is common in Permian and Triassic temperate communities, already present in tropical Gondwana by the Early Permian, and constitutes biographic province with North American affinities demonstrating that tetrapod dispersal into Gondwana was already underway at the beginning of the Permian. The occurrence of marine *Mesosaurs* from Africa and South America are the only well known Permian Gondwanian *tetrapods*. These records evidently indicate that Gondwanan tetrapods had adapted to both salt water and fully terrestrial environments, and achieved a broad geographic distribution, implying a deep history of tetrapods in the southern hemisphere. Their distribution clearly shows that all the land areas which we now recognized as separate continents were then still joined to one another for 'there does not even seem to have been any difference between faunas of Laurasia and of Gondwanaland (See also: Knoll, 2005).

These similarities continued in the Cretaceous. Thus, *Iguanodon*, a large herbivorous dinosaur, was present in China, Mongolia, Australia, England, India and several European localities and perhaps in United State. Similar is the situation with *Metaposaurus*, at typically northern form, from the Maleri Formation of India. It is known from Morocco, and distributed widely in Europe and North America. Also abundance of prosauropod saurichia dinosaurs, such a *Parotosaurus* in the Norian and Keuper beds of Europe, North America, China, Mongolia, Germany, Argentina, South Africa and United State is most remarkable. Even the *Trityolodonts,* once thought to be very rare, have now been reported from Europe, North America, China, Argentina and South Africa. In the Jurassic the fresh water fish faunas are rather scare and only few are known world-wide, *Lepidotes* is present in Kota Formation of India as well as in Europe, Australia, Argentina and China. This is also true of *Tetragonolepis*, *Pholidophorus and Barapasaurus* (Murray, et al., 2015). Prasad and Manhas (2002) reported *Triconodont* (eggs laying mammals) and *Docodont* mammals of Laurasian affinity from Kota formation of India were present in Africa, China, Siberia and South America. Martinez et al., (2013) as quoted by Haddoumi et al., (2015) has reported the presence of *Rhynchocephalians* mammals early as the Triassic in Europe, North America, Madagascar and South America. They achieved a more cosmopolitan distribution during Early Jurassic, adding Asia, Africa and India to their range. A large variety of vertebrate animals, frog and fishes suddenly made appearance in Kalakot area in Jammu and in the Kirthar Hills in Pakistan show remarkably strong affinity with the contemporary forms of Mongolia, China, Siberia, and Central Asia in the mainland of Eurasia and Europe. Of particular significance is the existence of small-sized *Palaeryctid* mammals, which bear strong affinity with those of Central Asia (Sahni and Bajpai, 1991; Barrett, et al., 2008). The non marine ostracode assemblages of the intertrappean beds at Asifabad and Takli show remarkable identity at the specific level with the Maastrictian (Upper Cretaceous) fauna of Central Asia, Mongolia and China (Bhatia et al., 1996). The close faunal and floral similarity bordering on identity of Central Indian forms with those of Eurasia provides impelling evidence for existence of land bridge between the landmasses in Upper Cretaceous permitting animal migration It was not only the mammals that immigrated, there were also frogs – which are highly allergic of saline sea water – that hopped their ways through the land corridor and reached as far as south as the Deccan, where their remains are found in the infratrappean and intertrappean beds (Sahni and Bajpai, 1991). The biotic distribution certainly rules out the possibility of Paleo-Tethys intervening between northern and southern landmasses. Very recently researchers of Catalan Institute of Paleontology, Spain have discovered that the ancestor of the present day rabbit lived in South-eastern Siberia confirming an important biogeographic barrier free link between Asia and Europe. The remains of *Amphilagus Tomidai*, a genus that lived about 15 Ma (Middle Miocene) ago was traditionally thought to exist in Europe, but remains of this mammal were located in Asia. How this distribution be explained with an oceanic Tethys (Para-Tethys) intervening between the two areas is difficult to envisage.

Therefore, the imaginary barrier, an oceanic Tethys, that had been presumed between Gondwanaland and the northern continents neither existed from Italy eastward, nor even Black Sea eastward, as a big gaping wedge, some 6000 km wide in the east, should be given up – it simply did not exist in the Paleozoic or Mesozoic, and perhaps never thereafter.

4. Paleoclimatic Evidence

One of the more convincing arguments advanced for treating Gondwanaland and Laurasia as two separated landmasses was that the former was known to have extensively and repeatedly glaciated particularly in the Permian (Du Toit, 1937), while the latter having a tropical climate. Polar wandering was then not known, and an ocean had to intervene to justify these climatic differences. It is now firmly established that the present South Pole migrated from Cambrian position in the north-west of Africa to its present position and the North Pole moved from a position in the present South Pacific to north-east Siberia in the Permian, and on to its present position. Thus, Lower Permian glacial deposits known in the past extensively from the southern continents, are known from areas in Verkhoyansk and north Siberia (Meyen, 1971).This perhaps eliminated the need to have an ocean separating the two landmasses, Eurasia could be a part of Pangaea and still be in the tropical belt. It was shown by Waterhouse and Bonham-Carter (1975) that the distribution of climatic zones was asymmetrical during the Permian, because glacial rocks of the southern hemisphere occurred in sequences followed by temperate and by paleo-tropical faunas, whereas in the northern hemisphere, polar faunas overlapped temperate fauns, but never tropical ones. This means that south polar conditions extended much closer to the equator than north polar conditions. Such a gross asymmetry implies that the North Polar Region was much smaller than the South Polar Region – in a climatic sense. Equally significant is the fact that Gondwana glacial deposits have been reported from the Everest, Bhutan and Spiti (Pascoe, 1975), Nepal (Waterhouse, 1987; Dhital, 2015), northern Tibet and Karakoram (Norin, 1946), East and Southeast Asia Terrane (Metcalfe, 2001) and eastern Kashmir, all from the Tethyan zone of the Himalayas, and lying well to the north of the Main Boundary Fault, that was considered by plate tectonicists to be junction of the northern and the Gondwana continents.

Of similar significance is the distribution of Cambrian evaporates from Somalia, vast area Hormuz salt in the Middle-East and southwest Asia (Boucot and Gray, 1987), High Zagros (Stocklin, 1968), the Salt Range (Pakistan), Kashmir (Pascoe, 1975) and Siberia – the warmest region during Cambrian (Meyerhoff, 1970; Boucot and Gray, 1987). Separated by an oceanic Tethys (Proto-Tethys), these areas would be on two isolated blocks thousands km apart. If brought together in an assembly with no intervening ocean, they form a compact oval. Not this it constitute evidence, but appears that Epeiric Sea in the region completely dried up and polar wandering put this region in a desert climate belt.

5. Paleogeographic Evidence

Ahmad's (1983) paleogeographic maps of the Eurasian region for the Carboniferous, Permian, Triassic and Jurassic periods and suggested that the Tethys was not oceanic in character, not at least during this crucial period of Earth. Instead, it was an epicontinental sea, transgressing and regressing frequently, covering the area from northern India to southern Siberia. It passed into the Yunnan-Malay Geosynclines' in the southeast and reached the Pacific coast in China and Korea. The Mongolian Geosynclines' climaxed in the Variscan times and the Tien Shan Geosynclines' might have continued till the Triassic, otherwise the area was unaffected by the orogenic activity since the Cambrian. In the north it continued into the Uralian Geosynclines', and perhaps an oceanic deep to the east of it. In the south it covered the area presently occupied by Tibet and the Himalayas in a progressively deepening basin, collected some 20-25 km of sediments, overlying a granitic basement, *without* any major tectonic breaks.

Interpretation of seismic and magneto-telluric studies (Gokarn et al., 2002) suggested crustal thickness of 60-70 km in this area, and led to the interpretation that it was a double thickness zone, with India having been over-ridden by Angaraland. To the north this area usually thick sediments is bound by the Kun Lun Foredeep.

6. Geological Evidence

Talent and Mawson (1979) pointed out that during Devonian the Nowsherha and the coeval Chitral faunas are entirely different, and so are the Altai and the Kazakhstan faunas from the Nowsherha fauna. On the other hand, the Nowsherha fauna is closely related to the Australian fauna. The ancient crystalline massif in the Punjab Syntaxes and Hazera forms a transverse bridge between Pamir Himalayas and the Afghanistan-Baluchistan block, and joins the Badakhshan massif with the Indian foreland. And the Punjab Syntaxes is cut from the Russian platform by the Alichur Fault. If this is accepted, the Indian Shield continued into the Russian platform and perhaps affected the entire course of the tectonic development of the region. This would, then, not support the contention of Le Pichon (1968, p. 3691) that the northern border of India was about 1000 km from the border of Eurasia. Recent deep seismic soundings by Russian scientist in the Pamir area reportedly indicate that the area is not formed by welding of two landmasses. Desio (1979, p. 115) agreed that the Karakoram Range may have a basement of Archaean rocks that continue into the Badakhshan massif to the north and the Salkhala formation to the south. Stocklin (1977) agreed that the Pamir block of continental crust structure formed an integral part of Gondwanaland in the Paleozoic. This situation has obtained in the Carboniferous as well, and the oceanic Tethys, during atleast these geological periods was perhaps in two parts. Sdzuy (1967) agreed that Asiatic Tethys was split up in to a system of seas separated by lands

7. Discussion

The above listed available evidences appear to be unequivocal in suggesting that the Gondwanaland continent was continuous with the Cathaysian and Angaraland continents on one hand, and with Eur-America on the other, providing free exchange of all forms of life, flora and fauna (including marine invertebrates – even of pelagic or benthonic habitant – fresh water forms, insects and vertebrates), subject to the restriction imposed by environmental factors. Paleogeographic maps of this region of Eurasia confirm that the sea covering this wide basin was epi-continental, with Precambrian folded and metamorphosed formations underlying the Paleozoic and Mesozoic beds (Ahmad, 1983). Such an epeiric sea perhaps studded with islands of different sizes, more or less ephemeral increasing or decreasing in size with each phase of regression and transgression, and sometimes providing land bridges, temporarily opening the gates for free floral and faunal migration in either direction. However, these islands are not to be mistaken for island arcs for they were merely topographic highs on a sialic continental crust. In this assembly of Pangaea there is no place for a wide oceanic wedge, as appears on Smith and Hallam (1970) reconstruction, and many other variant of the same. The evidence for the oceanic Tethys was drawn from supposition on the basis of computer generated re-assemblies of the contours along the Atlantic continental shelves (Dietz and Holden, 1970; Smith et al., 1980). The great wedge-shaped ocean that gaped eastwards between Laurasia and Gondwana can be made to disappear only on a globe of a smaller diameter as demonstrated by Carey (1976) i.e. by accepting Earth expansion, because this “gaping gore” cannot be closed on a globe of present diameter.

In view of the above lines of evidence it seems that the Tethys could not have been an oceanic basin in the Paleozoic, extending across the present Himalayan belt, and separating India from Angaraland. Owen (1976, p. 250) based on the sea-floor spreading data stated clearly, “indeed, the evidence of a former large Tethyan Ocean between Gondwanaland and Laurasia is non-existence and that there is ‘no need to infer the presence of Tethyan oceanic crust north of India. The ‘Ocean’ is only a geometric artifact”. Instead, it is believed that it probably was an intermittent epi-continental sea during this period of Earth’s history but was extensive at the time. Crawford (1974, p. 379), too, believed that the Tethys was epi-continental, and Smith (1971) wondered that the Tethys, if it existed seems to have vanished completely from the region to the north of India, whereas, Beloussov (1979, p. 209) considered that an oceanic Tethys was a myth. . Acharyya et al. (1975) stated that the evidence is “against wide and extensive Tethys between Gondwanaland and Cathaysia/Laurasia”, yet it was not specified whether their Tethys was an ocean or a sea nor what they would have considered a “wide and extensive” Tethys. In fact, all evidences suggest that this sea extended from the Himalayan area to the south of the Siberian platform. On the contrary, Kapoor and Maheshwari’s (1991), comments as to how Cathaysian elements “intruded in the Kashmir Gondwana” obviously lack perspective.

As far as the Precambrian time is concerned, paleomagnetic data suggest that Pangaea existed as a single supercontinent even in the Archaean (Piper, 1976; McElhinny and McWilliams, 1977). Goodwin (1978, p. 77) strongly supported plate tectonics and examined the distribution of Precambrian sialic crust and concluded that it retained a Pangaeain pattern throughout beginning around 2.5 Ga ago or that the global continuity of Precambrian crust within Pangaea is the outstanding feature. If these observations are added to those discussed in this study for the Paleozoic and the Mesozoic, there seems to be no escape from the fact that a single landmass, Pangaea, existed on the Earth from the Archaean to the Triassic, and may be later, and there is no evidence for a virtual shuttling of the continental landmasses, as presumed in the Wilson Cycle and Pangaea existed as a single unified landmass from Archaean and till it broke up, initiated by the opening of the Atlantic.

On the other hand, Permian glacial deposition in Peninsular India was followed by extensive freshwater sedimentation in the course of which thick to very thick coal seams were formed and must have taken millions of years. Marine conditions existed over parts of Peninsular India during glacial epoch, and the direction from which marine incursion came is still disputed. Freshwater conditions prevailed in the Himalayan region as well from eastern Assam to Nepal, and may be up to Kashmir, where a Permian coal seam has been discovered recently. How far north these freshwater conditions extended is not known, although the presence of *Glossopteris* flora in Tibet bespeaks of its continuation considerably up to the north. This could, perhaps, have been the most direct route for the flora, freshwater fauna and the vertebrates for their two-way traffic corroborating Tatsch's (1971) conclusions. It is, therefore, not surprising that the Gondwana forms occur in Thailand, western China and even Korea. Later, in the Upper Permian times, as also in Triassic, land routes must have existed across this continental sea during periods of more or less brief regressions.

Fig. 2 after Crowell (1979) shows Arabian- Afghanistan, and Tibetan fluvio-glacial areas added in the present study. Crowell avoided a vast ice cap, but failed to explain how these scattered glaciers or small ice caps happened to exist in rather low latitudes, depositing directly into marine environments in Peninsular India, Tibet, Karakoram and Arabia. Nor is it possible to explain the unique glaciations in Eastern Australia where refrigeration lasted from Upper Carboniferous to Upper Permian more or less continuously with South Africa and even Antarctica had only comparatively brief spells. Moreover, if the paleomagnetic data are accepted the pole lasted from around 325 to about 250 Ma within Antarctica but no evidence in support for this long spell in forthcoming so far. A very rapid polar wandering from Upper Carboniferous to Upper Permian, spreading glacial deposits far and wide, and thereby giving rise to the Gondwana concept may explain the above situation. Ahmad (1960) envisaged such a unique polar migration which takes accounts of all the then known Paleozoic glacial deposits in Gondwanaland.

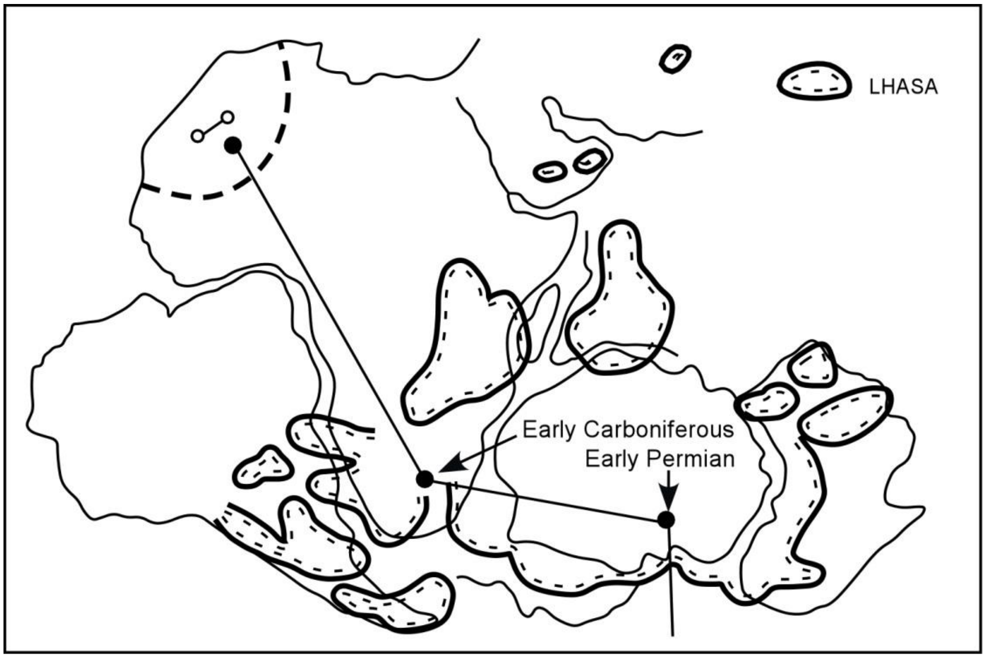

Figure 2 Map showing glaciated areas during Gondwana (after Crowell, 1972), with the fluvio-glacial deposits in Saudi Arabia, Iran, Afghanistan and Tibet added on. Note it would be impossible to have areas so far away being affected by glaciations, with the Early Permian pole indicated

It is, nevertheless, obvious that the paleomagnetically located Permian Pole derived from South Africa rock formations, conforms that the Upper Permian pole derived from glacial data (Ahmad, 1960). Floral evidence in support of an Upper Permian age for the Dwyka Glacial is significant (Metcalfe, 2001).Thus, the long-lived *Gangamopteris cyclopteroides* is the only species of this genus known from two localities in South Africa, suggesting that the species had existed in the area in the pre-ice cap period, but died out while the ice cap lasted over the region. This would perhaps indicate an age towards the end of the Permian, and not the base of the Permian, as in India, for *Gangamopteris* became extinct at the end of the period.

Fig. 3 gives a generalized paleogeographic map of Pangaea for the period Cambrian to Mesozoic. The oceanic Tethys, as pointed out earlier, was entirely epicontinental. Indeed, in the Devonian and the Carboniferous it was divided in two parts by a promontory from Chitral area (Pakistan) northwestward into the Russian platform and southeastward in the Indian Craton. Simultaneously, a number of extensive geosynclines existed throughout the Paleozoic and perhaps some shifted extensively, whereas others remained active in the same area. It appears that soon after the opening up of the Atlantic, the geosynclinals activity declined rapidly and by the end of Mesozoic there was hardly any left on the Earth.

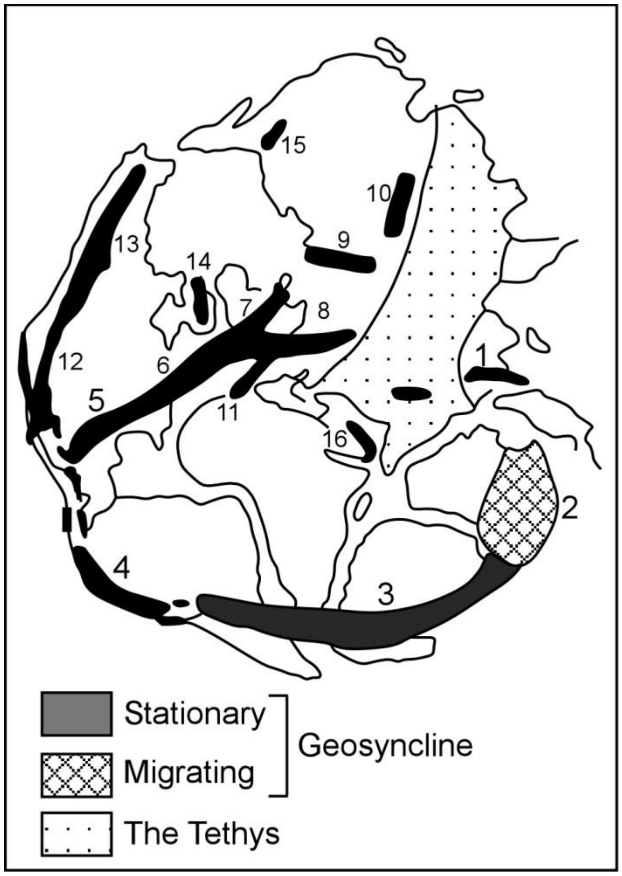

Figure 3 Paleozoic- Mesozoic paleogeography of Pangaea. 1. Yunnan-Malay; 2. Adelaidian to Tasman (including Beardmore and Borchgreyvink of Antarctica); 3. Samfrau; 4. Andean; 5. Ouachita; 6. Appalachian; 7.Caledonian; 8. Hercynian; 9. Ural; 10. Altai; 11. Mongolian-Amur; 12-13. Cordilleran-Nevadan-Laramie; 14. Franklin-an; 15. Cherskyi; 16. Hormuz-Oman; 17. Atlas (Hercynian).

Indeed, this entire area have been cut through and through by a succession of geosynclines in the Precambrian, and perhaps they converted it into a mature sialic crust, but by the time of the Cambrian, except small Tien Shan Geosynclines no part of this extensive area belonged to a geosynclinals set up. Thus, it appears that the oceanic Tethys coexisted with a large part of the Earth belonging to geosynclinals regimen, under marine conditions.

This epicontinental “Tethyan” sea must have been interspersed, as discussed above, with a number of islands, on occasion perhaps broken up by actual land bridges, opening the gates for vertebrates, insects and freshwater faunal elements migration. Owen (1976) believed that an epi-continental Tethys “was extensive at the time”. Kamen Kaye (1972) had no doubt that the Tethys was superimposed on a continental crust, whose granitic and metamorphic layer was formed as result of earlier phases of tectogenesis. These Tethyan sediments are, by and large; undisturbed and not only is the unconformity underneath obvious everywhere in Central Asia, but clearly correlatable and continuous formations cover vast areas. This is supported by the field studies by Colchen (1975) in Nepal Himalayas, concluded that “form Precambrian to Upper cretaceous or Middle Miocene, is a period of sedimentation and epeirogenesis. The sedimentation is of epicontinental type, characterized by a platform’. This basin accumulated thick sedimentary sequence, without any breaks or tectonic disturbance, of the order of about 20-25 km in thickness, over granitic crust giving rise impression of doubled up sialic crust. If the above interpretation that the Tethys was epicontinental in central Asia is accepted, it would follow that India has not migrated from the southern hemisphere, as often suggested on paleomagnetic evidence (see: Rao and Rao, 2006 for references therein) and instead, it has always been where it is, except for a counter clockwise rotation, beginning around 65 Ma when Carlsberg Ridge came into being. The voluminous outpourings of Deccan lava were taken place and the Peninsula in its lower part was pushed eastward. Evidences based on disjuncts does not support a position for India besides South Africa, and the paleontological arguments discussed above may finally settle the issue.

Read and Mamy (1964) recorded the existence of *Gigantopteris* flora from northwest Texas, Oklahoma, and New Mexico. *Gigantopteris* is a characteristic form of the Permian of Cathaysia (Southeast Asia), and adapted to tropical climate. It has been reported from Anatolia, that was part of Gondwanaland (Meyen, 1979).Yet, its presence in North America is of particular significance, for it could not possibly have migrated via Bering Sea, as northeast Siberian region was having a glacial climate at the time, and was indeed frozen over, with the North Pole in the vicinity. A direct crossing, even accidental, over such a vast ocean as the pacific, may also be ruled out, and there seems to be no escape but to consider a smaller Pacific- a proto- pacific – perhaps even smaller that on Carey (1976, Fig. 170). But this is possible only on a globe of considerably smaller diameter. The phenomenon of Earth expansion has been independently explained and demonstrated in several recent researches on the basis of weight and size of dinosaur in relation to gravity (Hurrell, 2011), empirical crustal research taking latest ocean floor data (Maxlow, 2015) and Neutrino Radiation (Meyl, 2015).

8. Conclusions

Paleogeographic and other lines of arguments confirm that the Tethys was an epicontinental sea, and was nether geosynclinals nor oceanic. This shallow sea was transgressing and regressing frequently resulting the formation of several islands above its sea surface, but occasionally there was land connection apparently a narrow land bridge and permitted regular two-way traffic of floral and faunal forms. Sediments in the Tethyan area are characteristically platform type and perhaps locally geosynclinals. Tethys existed as an epicontinental sea which covered large areas of central Eurasia from Cambrian onwards and continued until middle Mesozoic with only insignificant changes in its geography brought about by recognized Orogenic or Epirogenic activities followed by withdrawal of sea until it completely regressed from the area between Late Cretaceous and Early Eocene.

As no oceanic Tethys existed, neither Carboniferous-Permian Paleo-Tethys nor Permian-Triassic Neo-Tethys opened up and India was continuous with rest of Asia. And India has not migrated from the southern hemisphere to collide with the northern landmass in the Oligocene or Miocene; this collision according to plate tectonic concept being responsible for the Himalayan orogeny, the Indus-Tsangpo forming the suture zone along which the two continents are welded. The tectonic activity in this region was undoubtedly 100 Ma earlier than the supposed collision and no explanation has been offered for this anomaly. If the Himalayas have not originated as a result of collision, the explanation for their genesis must be looked for. Distribution of Paleozoic and early Mesozoic vertebrates, plants, freshwater forms, elements of marine life which could not cross oceanic deep, establishes that the Indian craton block continued into the Chinese and Siberian platforms till at least the Triassic times, and that the oceanic Tethys, and hence an independent Gondwanaland are myths.

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