CHAPTER 3

CONTINENTAL DRIFT AND EARTH EXPANSION

“Then Yima stepped forward, towards the luminous space, southwards, to meet the sun, and pressed the earth with the golden ring, and bored it with the poniard, speaking thus: ‘O Earth, kindly open asunder and stretch thyself afar, to bear flocks and herds and men’.

And Yima made the Earth grow larger by three-thirds than it was before, and there came flocks and herds and men, at his will and wish, as many as he wished.”

— Zend-Avesta, Vendidad, Fargard II, verses 18-19

Continental Drift

We turn now to quite a different part of the world, a different time, and a very different topic. The topic is what is now called Continental Drift, the place is Paris, and the time is 1858. In that year Antonio Snider, an American working in Paris, published a book.

This book [Snider, 1858] drew attention to the remarkably good match between the west coast of Africa and the east coast of South America. Snider suggested that this good match was because Africa and South America were once a single continent, which had been pulled apart in some way to form the present coasts (Fig.3.1). He gave a drawing of the combined continent, showing also Europe and North America joined, and even Australia joined to eastern Africa.

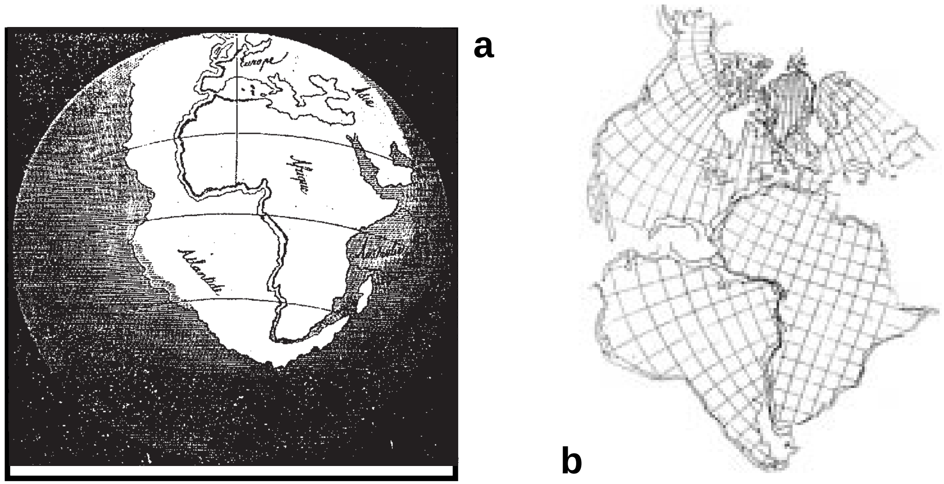

Fig. 3.1. Pre-Atlantic Ocean according to: a) Snider ; b) Bullard

This work was lost sight of in later years, but the topic was revived in 1915 when the German scientist Alfred Wegener published another book on the topic of how the continents were formed [Wegener, 1915]. Wegener’s work, unlike that of Snider, attracted considerable attention, and quite a lot of supporting comment. It really explained a lot, and if you could only

accept the possibility that the continents could actually move relative to one another, the logic of the proposal seemed clear.

Nevertheless, over the years support again waned. It did not pick up again until 1964, when Sir Edward Bullard published a paper [Bullard, 1964] which included a computer-based fit of the coasts of South and North America against Africa and Europe (Fig. 3.1). As this work was computer-based, of course it had to be right, and from that point on the concept of Continental Drift finally began to achieve general public acceptance; it only took a little more than 100 years!

This work considered only the lands on either side of the Atlantic. Some interesting observations had been made of the occurrence of fossils of a plant genus, *Glossopteris*, in rocks in Africa, Australia, India, South America, Antarctica, and New Zealand. Of course it is only a matter of logic that plants in the same genus must have had common ancestors, and these ancestors must have existed together within a single area — otherwise they wouldn’t have been able to breed.

> *Proposition 3A*
> *Plants in the same genus must have had common ancestors, and these ancestors must have existed within a single area*

As the rocks containing the *Glossopteris* fossils are now widely separated, then using the principle of Continental Drift it was only natural to assume that these rocks were in continental masses which had drifted apart, and it was not hard to suggest how they had once fitted together (Fig. 3.2).

Further support for the idea came from a study of rocks which had been affected by an ancient glaciation, assumed to be an early south-polar icecap. Notice in Fig. 3.2 that India is part of this ancient super-continent, which has been called Gondwanaland. The drift of India northwards, and its collision with the rest of Asia, is assumed to be the cause of formation of the Himalaya Mountains.

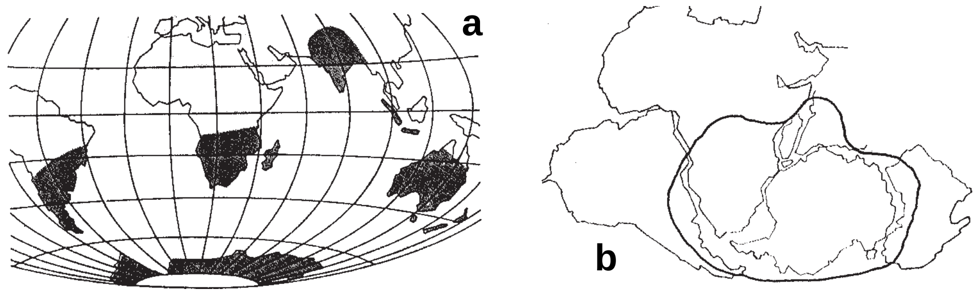

Fig. 3.2. a) Sites of Glossopteris *fossils ; b) Suggested former grouping of land around the South Pole*

Additional confirmation for the occurrence of continental drift came from studies of magnetism in rocks (paleomagnetism). Certain rocks are slightly magnetic, containing ‘magnetic domains’ which are areas of the rock magnetically aligned in a certain direction.

This magnetic direction is set by the Earth's magnetic field as the rock cools down from a hot state, and points towards the Earth's magnetic poles.

Our magnetic poles are in a different position to the geographic poles, and also vary slowly but continuously, both in position (currently the North Magnetic Pole is 11° away from the geographic pole, somewhere off northern Canada) and in strength. The polarity of the Earth's magnetism may also change, with the North and South magnetic poles interchanging in position.

By looking at the magnetic directions in old rocks of the same age, but in different continents, it becomes apparent that these continents must have shifted relative to one another — the magnetic poles they point to are not in the same place. This technique has been used to trace the apparent movement of the magnetic poles over the Earth's surface in the past.

The parts of the surface which move as one have been called 'plates', and the study of their movement 'plate tectonics'. We will see later on that the term 'plate' is not an apt one.

The currently accepted position is that the northern continents of North America, Europe, and Asia without India were once a single super-continent (called Laurasia), which, together with Gondwanaland, previously made up a single continent containing all the present land areas; this has been named Pangaea (Fig. 3.3). There is now convincing evidence that Pangaea really did exist as a single landmass about 200*my* ago, and that it has since split apart, first to form Laurasia in the north and Gondwanaland in the south, after which each of these supercontinents again split further into parts, which drifted away to form the present disposition of the continents.

Fig. 3.3. A reconstruction of Pangaea

Continental drift has 'come of age'; the fact that it occurs is no longer seriously doubted, even by more conservative scientists. It is a good example of a scientific theory, one which explains many observable features of the real world in a simple, coherent, way, and for which no alternative and more simple theory has yet been put forward.

When it comes to the *cause* of continental drift, however, the position is very different indeed.

The Convection Current Theory

In searching for a mechanism for continental drift, geophysicists came up with the idea of convection currents. The interior of the Earth is widely believed to be hot, molten in parts, and it was suggested that the molten rock moved in convection currents, like water boiling in a saucepan, and the movement of these currents forced the parts of the old supercontinents apart.

The convection-current proposition for the mechanism of continental drift has achieved an amazing acceptance, and appears in all current standard geological textbooks. The acceptance is amazing because it is a proposition wholly without any supporting evidence or plausible basis. In my view it is completely wrong.

Of course the energy required to move whole continents around is extremely large. No plausible source for this energy has ever been suggested, as far as I know. No reason for the convection currents to break up into the assumed 'convection cells' has ever come forward.

> *Proposition 3B*
> *The convection-current mechanism for continental drift lacks any supporting evidence or plausible basis, and is completely wrong*

We will return to this point later on, and suggest an alternative mechanism for driving continental drift which does not suffer from these drawbacks.

Sea-Floor Spreading

During the 1960's, scientists came to learn a lot more about the structure of the sea bed, and some very interesting facts came to light. Of course, by this time, accurate methods of dating the ages of rocks were well known. A series of massive structures, called 'mid-ocean ridges' (Fig. 3.4), were discovered running down the middles of the major world oceans, and these were found to be the sites of volcanic activity, producing new rock (age zero years).

As you move away from a mid-ocean ridge, you encounter progressively older rock, on either side. All the rock is of oceanic type, common to sea-beds all over the world, and quite different in nature to the rocks of the continents. The oldest oceanic rock, that most distant from a ridge, is only 200*my* old.

Because much of the newly-formed rock had magnetic content, the paleomagnetic techniques described earlier in this chapter could be used to date the rocks in great detail. On either side of the ridge, 'stripes' of rock are being formed, with the edges of the stripes representing changes in polarity or strength of the magnetic fields. The ridgepoint itself looks like a mirror, with a pattern of stripes of given age and magnetic properties reflected on either side.

The picture given was quite clear and unambiguous. At the ridges, new rock was being formed along a roughly continuous line down the ridge, and spreading off to both sides to permit even newer rock to appear. It is perhaps understandable that these ridge-lines could be interpreted as the positions where convection currents were welling up from the Earth's mantle, bringing with them molten rock to solidify and spread apart.

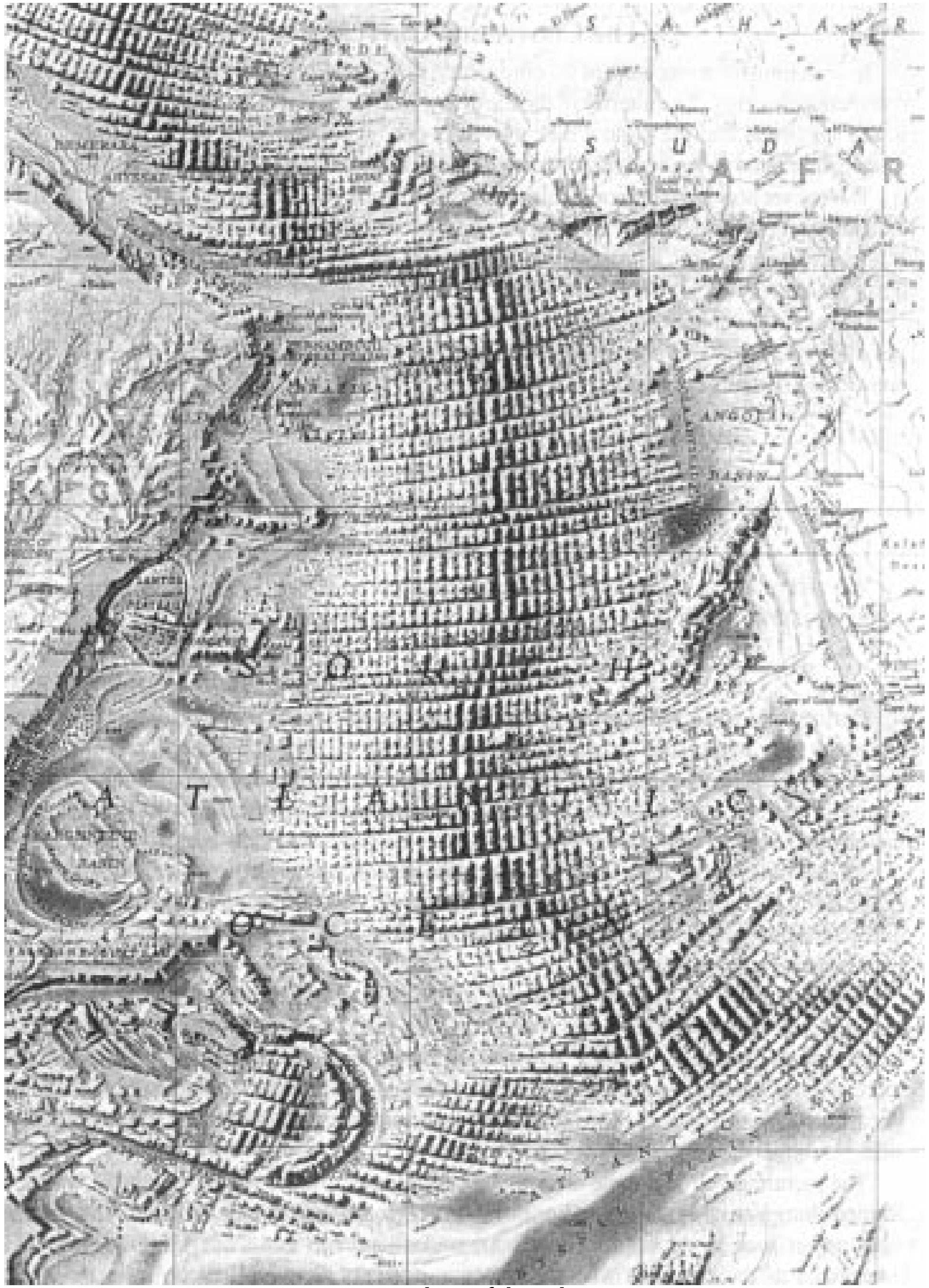

Fig. 3.4. Floor of the Atlantic Ocean

The phenomenon involved, called sea-floor spreading, appears to have created the whole of the present ocean floors during this period of 200*my*. The rate of spread varies from one ridge to another, but is something like 2-4*cm* per year — about as fast as your fingernails grow.

The fact that sea-floor spreading actually occurs is no longer in any real doubt. The driving mechanism behind it, however, is again quite a different story.

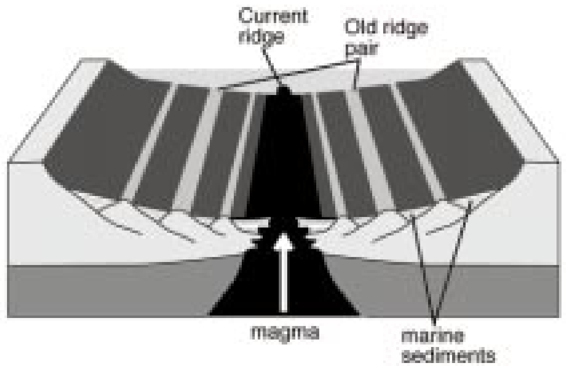

Fig.3.5. Sea-floor speading at a mid-ocean ridge

The 'Subduction Zones'

If the sea-floor was expanding at the mid-ocean ridges, where was the new surface material which was created ending up? The suggestion was made that it was disappearing down the deep ocean trenches, and either piling up under the continents, or being melted and recycled by the convection currents to appear eventually at another ocean ridge.

Although this is the currently accepted dogma, it seems to me, and others (eg [Ciric, 1981]), to be a concept which almost completely lacks any supporting evidence. It seems against logic, if one plastic plate is being pushed against and under another, for a deep trough to be formed between them. The deep ocean troughs are not continous, and do not show any of the signs of rock in motion downward, deep into the Earth. And, in the case of the mid-Atlantic ridge, there are no deep ocean troughs along the Atlantic coasts for the re-cycled rock to disappear into.

Peter James, an engineering geologist, has looked at the position from the viewpoint of the physics of materials. He concluded that 'serious difficulties exist in trying to reconcile the observed crustal features with a conventional model of mobile plate tectonics — at least on our present knowledge of material behaviour' [James, 1987].

Another problem with the subduction theory is explaining away just where the huge volumes of rock involved are ending up. The whole of the present Pacific Ocean, an area representing around one-third of the entire current surface of the Earth (more than the total land area!), has opened up during the last 200*my*. The bed of the Pacific varies in depth, but averages around 4*km* below current sealevel.

Carey [1987] has pointed out that the subduction theory just does not explain where these huge volumes of rock, more than a million cubic kilometres of material, ended up when the Pacific Ocean was created. If they were spread evenly under the present continents, these would be some 7*km* higher than they are now, just with the material from the Pacific alone (current average height of the continents is no more than 1*km* above sealevel). If the rock was really recycled in the mantle, to reappear at the mid-ocean ridges, then the Pacific would have always have had to have been its present size and depth, and not created from scratch in the last 200*my*.

The subduction theory is thus a literal attempt to sweep a problem away under the carpet — in this case, the carpet of the continents. Now is the time to drop this theory down one of the ocean trenches.

> *Proposition 3C*
> *The subduction theory lacks supporting evidence and plausibility, and is completely wrong*

Expansion of the Earth

If we return now to Bullard's fit of Africa against South America (Fig. 3.1), you will notice that as you move away from the central point of contact, the match becomes less good. In 1955, Warren Carey, Professor of Geology at the University of Tasmania, pointed out [Carey, 1955] that the match would be much better if the two continents were curved around an Earth of smaller radius. This was the beginning of the current phase of the Expanding Earth theory.

The basis of the Expanding Earth proposition is that the current continental masses were once all joined completely together, covering the whole surface of a much smaller Earth. This has since expanded internally, the current continents splitting apart and distributing themselves over the enlarged surface. In other words, the current deep-sea areas did not exist in their present conformation in earlier times, but have been formed by the expansion of the Earth's core under them.

At present, about 70% of the Earth's surface is covered by sea. If the present 30% surface which is land had to cover the whole of a smaller sphere, that sphere would be about 55% of the diameter of the present Earth. Instead of the current radius of about 6,400*km*, the radius would have been around 3,500*km*. The circumference of the present Earth is 40,000*km*, but an 'unexpanded' Earth, in which Pangaea covered the whole surface, would have a circumference of about 22,000*km*, that is, 18,000*km* less than now.

It is interesting to calculate how long this expansion would have taken, at the present rate observed in sea-floor spreading. Since the rate at each ridge is around 2-4*cm/yr*, and there are usually 3 ridges crossed in going right round the Earth, the total present expansion is very roughly 9*cm/yr*. Dividing this into 18,000*km* gives an expansion time of 200*my*, which agrees quite well with the time from rock age-dating.

Fig. 3.6. Unexpanded Earth views according to Barnett

The Expanding Earth concept is not in conflict with Continental Drift, in fact we shall see that the two are closely linked. Under an expanding Earth, the single continent Pangaea which existed around 200*my* ago would not have had exactly the conformation shown in Fig. 3.3,

instead the outer edges of Pangaea would have wrapped round a much smaller Earth and be in contact, thus enveloping the whole Earth.

Further models of the pre-expanded Earth were constructed in the recent phase of interest, such as that made by Barnett [1962]. Several views of this model are shown in Fig. 3.6. Notice that Barnett's model is fairly 'loose', with many large gaps not covered by land, and that some large movements and rotations of the land masses have been suggested, such as Australia moved against North America, Greenland moved a long way over the top of Canada, and so on.

Early Work on an Expanding Earth

As with the Continental Drift theory, there were earlier workers who had suggested the possibility that the Earth was expanding. One of these was Hilgenberg [1933], who produced globes of the Earth at various stages of its expansion (Fig. 3.7).

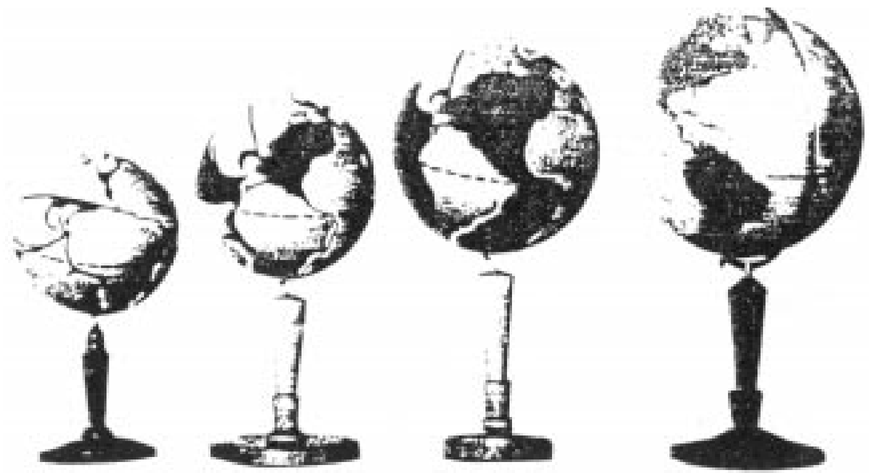

Fig. 3.7. Globes of Earth expansion according to Hilgenberg

A fascinating fact of history is that it was suggested as early as 1859 that the Earth was expanding; this was in a book by Alfred Drayson, entitled 'The Earth We Inhabit: its past, present, and probable future'. This book [Drayson, 1859] came out only one year after Snider had published his early work on Continental Drift!

Drayson is described on the title page as 'Captain Alfred W Drayson, Royal Artillery, author of "Sporting Scenes in South Africa", &c' — not the background one would expect for someone producing fundamental thoughts on the Earth's structure.

Much of Drayson's evidence for expansion does not stand up to examination in the light of modern knowledge, and he enormously overestimated the rate of expansion, at around 6000*cm/yr*, as against the current estimate, one thousandth of the size. But it must be remembered that in Drayson's time, the great age of the Earth had not yet been established — the accepted value then was perhaps 40,000*yr*, so naturally the rates for associated phenomena would be well out.

Some of Drayson's observations are still valid. He noted unexplained fractures in deep undersea cables. In his day, these cables were clad in rigid iron. If the forces rupturing an undersea cable applied along its whole length, then expansion could have been at the rate estimated by Drayson. In fact they presumably only applied at mid-ocean ridges or ‘plate boundaries’, only at the places where the fractures actually occurred.

Fig. 3.8 is a reproduction from Drayson’s book. He says “perhaps it [the Earth] was once very small, perhaps as small as fig.1., whilst the present earth is the size of the larger circle.” It is interesting that the proportions shown in Drayson’s diagram are very close to those currently assumed for an expanded and original Earth.

Copies of Drayson’s book are quite rare, and its existence does not seem to have been picked up by anyone else interested in the expanding Earth idea. However, if you search long enough, you can almost always find a possible earlier reference — the match across the Atlantic coasts was noted as early as 1620, by Francis Bacon! An even earlier reference to expansion of the Earth is that quoted at the head of this chapter. This is from the Zend-Avesta.

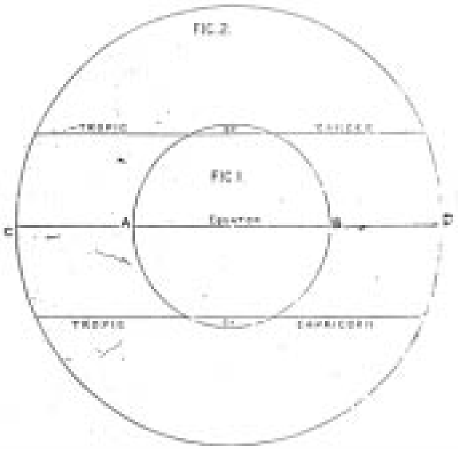

Fig. 3.8. Present and unexpanded Earth cross-sections, from Drayson [1859]

Thus Spake Zarathustra

The Zend-Avesta is the sacred book or bible of the Parsees, followers of Zoroaster. Zoroaster (another form is Zarathustra) was the founder of one of the most ancient religions still extant — he was active in the area now known as Iran, at a date not known with certainty, but believed to be around 1000 BC.

Of course the reference in the Zend-Avesta presumably has no scientific relevance, but it does justify the claim that expansion of the Earth has been a topic for some three thousand years!

ADDENDUM

Readers interested in the *geological* evidence for an expanding Earth should consult Warren Carey’s new book ‘Theories of the Earth and Universe: a History of Dogma in the Earth Sciences’ [Carey, 1988]. This gives a very thorough examination of the matter, and also brings out the knee-jerk tendency to react to revolutionary new ideas in science with ridicule, even when they are supported by the soundest evidence. If these ideas have the support of logic and evidence, then of course they do win out in the end, sometimes even bringing ridicule on those who rejected them out-of-hand when they first appeared!

CHAPTER 4

THE DISTRIBUTIONS OF NUT TREES

"I went down into the garden of nuts to see the fruits of the valley, and to see whether the vine flourished, and the pomegranates budded."

— Solomon's Song

What (or who) is a nut?

So far in this book we have looked at how plants spread and change, and at the evidence for the occurrence of Continental Drift and Earth Expansion. Now we will combine these two diverse topics, to provide a new approach to determining specific details of these movements of the Earth’s crust, using first as an example the area of nut trees.

Because the term ‘nut’ is applied to a whole range of different plant structures, occurring across almost the whole gamut of plant life, nuts are a useful starting point for this work. To the botanist, ‘nut’ has a much more specific meaning than the general understanding. What we call a nut may be a seed, a fruit, a tuber (tiger nut), a bulb (water chestnut), a pod (peanut), or any one of a range of specialized plant structures to the botanist.

Nuts not only grow on trees, they grow underground, under and on top of water, in giant gourds on 30-metre vines, in jungles, deserts, everywhere from the tropics to within the arctic circle. Examples of things called or treated as nuts occur in most of the main plant families, and appear in both the gymnosperms (conifers) and both branches of the angiosperms (broadleaved plants). Even the ginkgo, that strange fossil half-way house between them, is a nut producer.

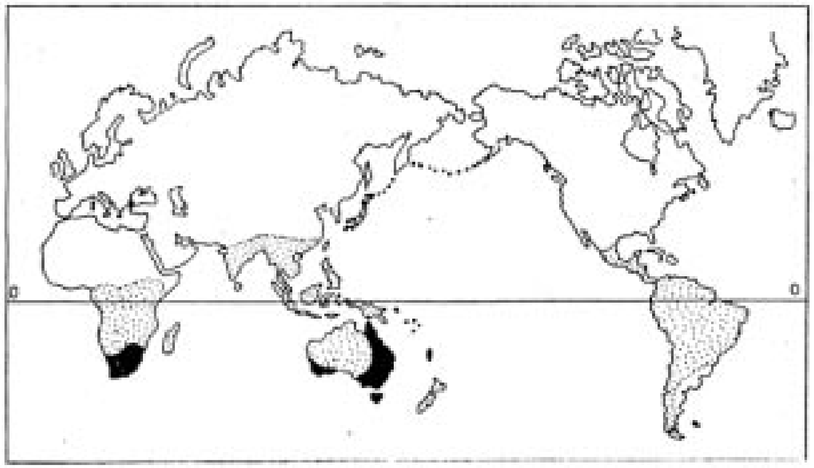

Fig. 4.1. Distribution of the Proteaceae [Rao, 1971]

In Fig. 4.1 is shown a world map giving the present distribution of the Proteaceae, the plant family containing the macadamia nut, the avellano, and some other less well-known nuts. The dark parts show heavy concentrations of species, the lighter shading the more lightly populated areas.

Now remember the principle (Proposition 3A) that species that are related must have had common ancestors existing in a single range. The only way for the current distribution of the Proteaceae to have come about, is for the species to have spread naturally by their inbuilt dispersal mechanisms (the conventional view), or for the areas of population to have been in contact with each other in the past and since moved apart through continental drift, or a combination of both.

The Continental Drift approach, which is not disputed at this time, provides a satisfactory broad-scale explanation. The continents involved are the same southern ones as those concerned with the *Glossopteris* fossils (Fig. 3.2). Notice, however, that the modern Proteaceae extend beyond the range of the Glossopteris fossils, and in particular exist all over southeast Asia and up into southern China.

Now look at Fig. 4.2, the distribution of species of true pines *(Pinus)*, containing many nut-bearing trees. Notice that this map more or less complements the first one; there are only small areas of overlap, in Central America and the Malesian area, and these are well within the range of what might be expected from natural dispersion.

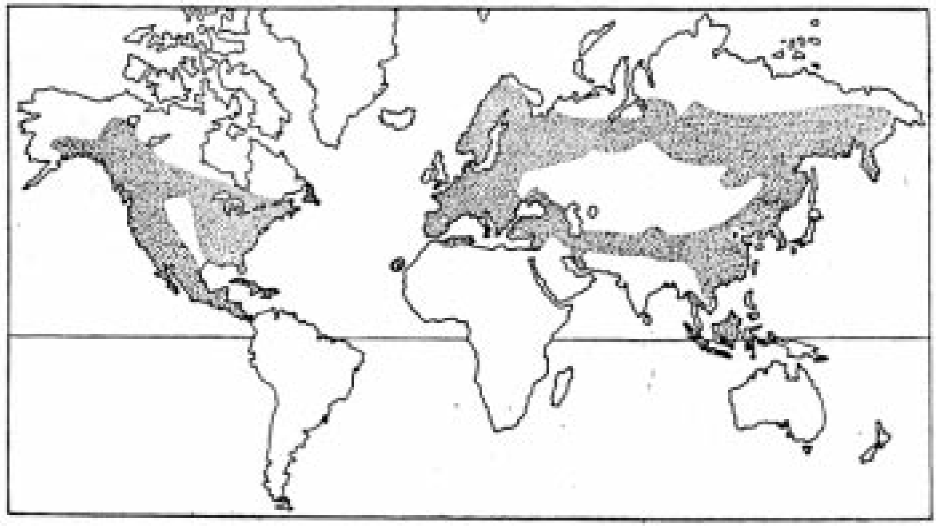

Fig. 4.2. Distribution of Pinus *[Maheshwari, 1971]*

The distribution of pines is paralleled also by that of the oaks, species of *Quercus* and some close relatives. People with European connections tend to think of oaks as a typical European tree, but in fact there are two areas with high concentrations of oak species. One is in the U.S./ Mexico region, the other is in southeast Asia. In spite of this, native oaks are completely lacking in the adjacent areas of Australia and South America, just as with the pines.

We will see later on that this situation is repeated with many other plant families. The explanation is fairly obvious at this point — the Proteaceae developed in Gondwanaland, and the pines and oaks in Laurasia. This is an unremarkable continental drift implication.

> *Proposition 4A*
> *Plant families tend to be identifiable either with Gondwanaland or with Laurasia*

Now to move on to some detailed distributions. First, in Fig. 4.3, we see the distribution of species of *Elaeis*, the oil-palm, and a major world source of oil from its kernels and fruits. In view of the accepted former juxtaposition of Africa and South America, this distribution is entirely as might be expected.

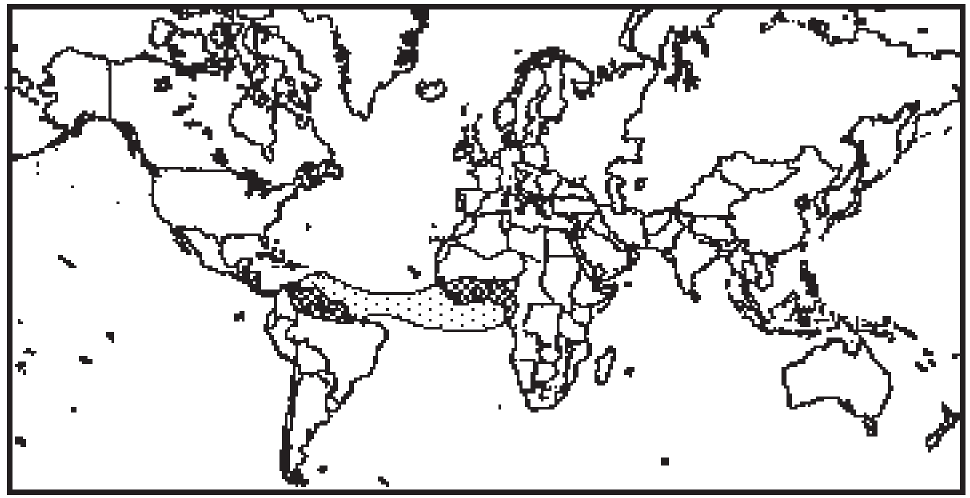

Fig. 4.3. Distribution of Elaeis

In Fig. 4.4 we have the map for the Araucarias, sources of those excellent nuts the Bunya Pine in Australia, the Monkey Puzzle in Chile, and the Paranà Pine in southern Brazil. Another species is the Norfolk Island Pine, and there are also species in New Guinea. The inference from this map is that eastern Australia once fitted against the west coast of South America, and if you try it with a model, you will find that this match is a very good one.

This distribution is our first hint that the 'basic' continental drift theory requires modification. No conventional reassembly of the Earth on a sphere of current size (eg Fig.3.3) places Australia against South America; in fact the plant distributions show that this link is both strong and relatively recent.

> *Proposition 4B*
> *Plant distributions are evidence that the Expanding Earth proposition represents the situation better than the simple Continental Drift theory*

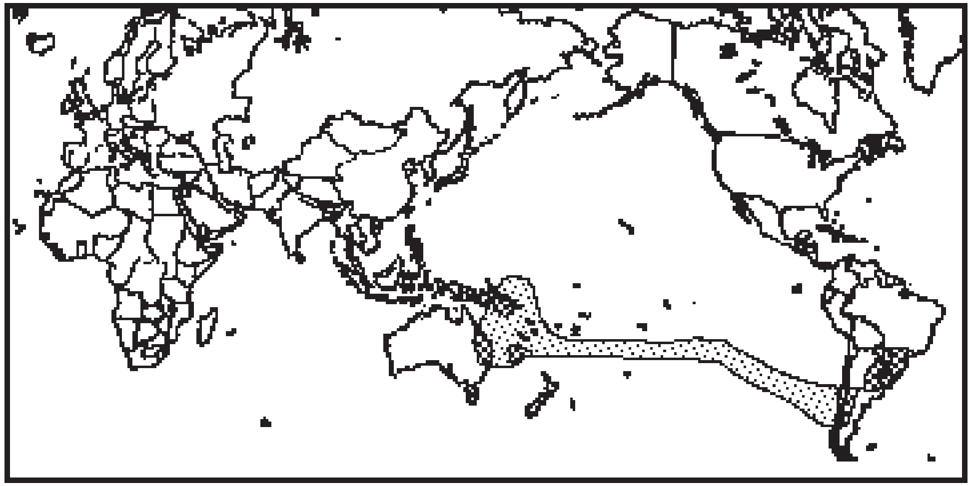

Fig. 4.4. Distribution of Araucaria

The next map (Fig. 4.5) shows where the three species of *Gevuina* exist , in Chile, eastern Australia, and New Guinea. The Chile species produces the Avellano or Chile Hazel nut, and the Queensland species also produces an edible nut [Irvine, 1980]. These two species are some 13,000 km apart, about one-third of the distance round the planet. It would be hard to explain this as chance dispersal, say by drifting on ocean currents.

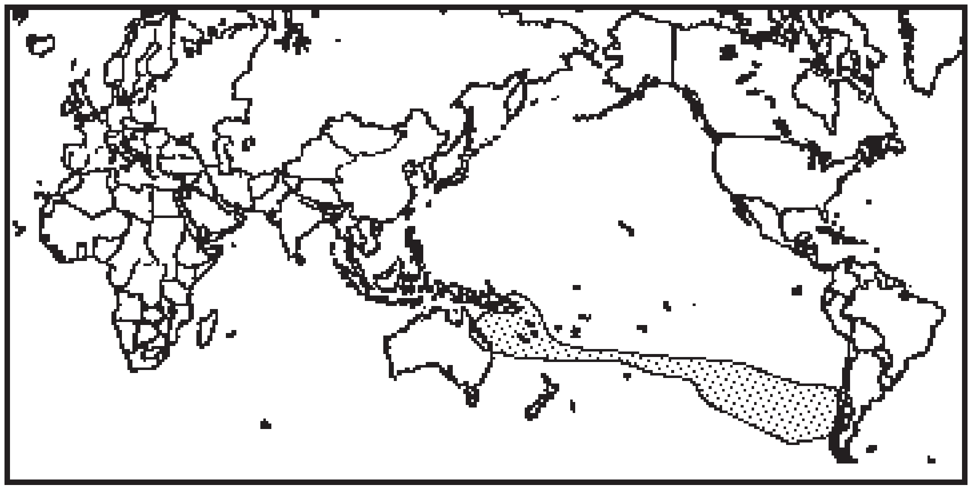

Fig. 4.5. Distribution of Gevuina

The distribution of *Adansonia*, the boab or baobab family, is shown in Fig. 4.6. There is one species in Africa, extending to India (allegedly introduced by Arab traders!), and one in northwest Australia. But the real concentration is in Madagascar, which has around 12 species. The distribution suggests that Western Australia was once in contact with the east coast of southern Africa, or possibly both were linked through Madagascar or India.

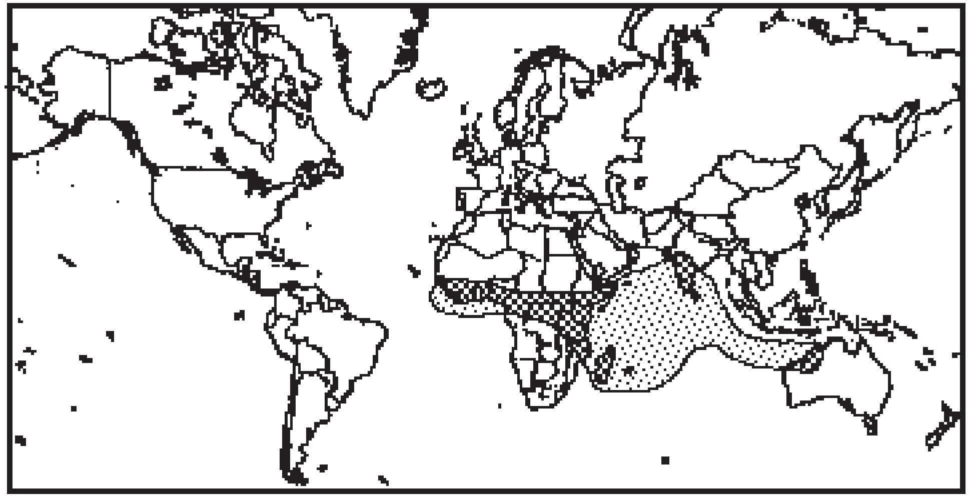

Fig. 4.6. Distribution of Adansonia

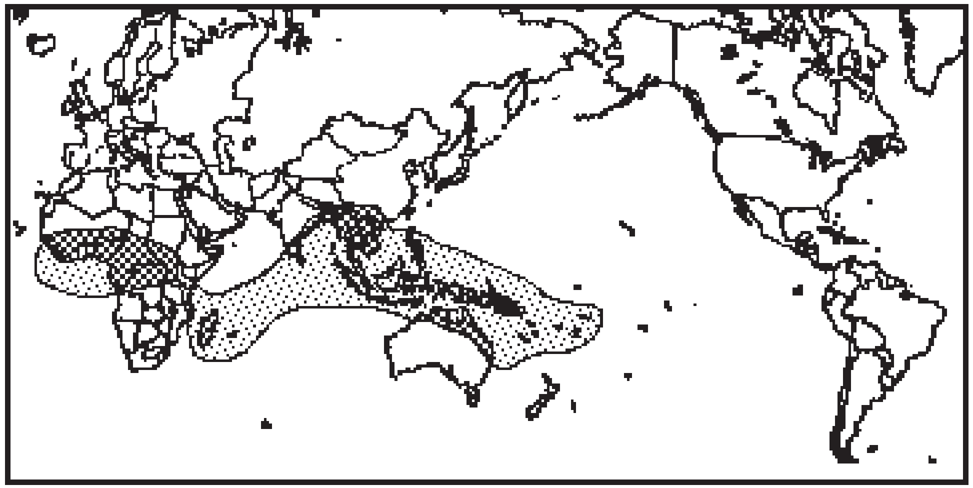

Fig. 4.7. Distribution of Canarium

The next map (Fig. 4.7), the distribution of the *Canarium* family (which contains the pili nut and the java almond), again links Madagascar with Africa (a more central spot) and with the areas of southeast Asia, the Malesian archipelago, and northern Australia. The range extends well out into the islands of the Pacific.

Similar links, displaced somewhat to the south, are shown by the distribution of *Santalum*, the Sandalwood family (Fig. 4.8). The focus of the family is in Australia, and it includes the Quandong, a native West Australian nut. Important former sandalwood sources are in India, Timor, and in Hawaii; there is one species in New Zealand, and there was one on the tiny Juan Fernandez islands right across the Pacific off the coast of Chile. There is also a close relative, once classed in *Santalum* but now given its own species (*Colpoon*), in the Cape area of Africa.

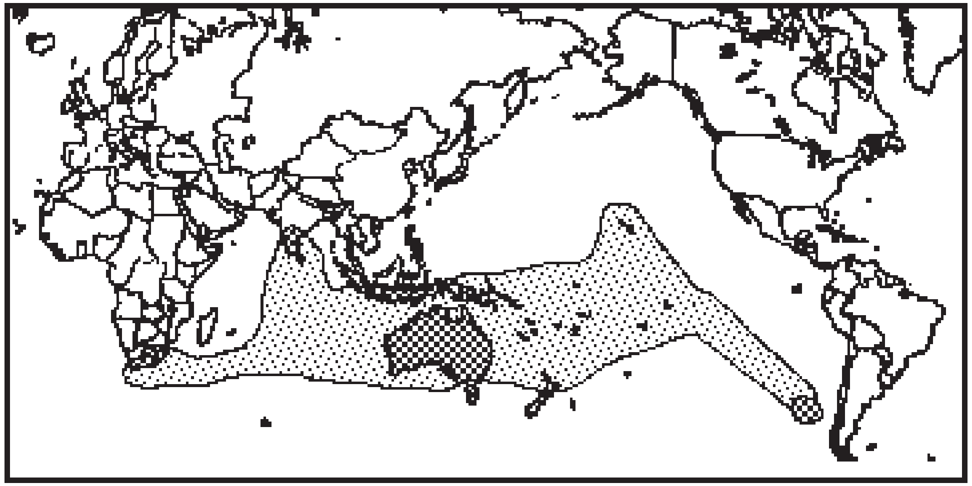

Fig. 4.8. Distribution of Santalum

Links between central Africa, Madagascar, the Malesian islands, northern Australia, and Central America are shown by the range of Omphalea (Fig. 4.9), which contains many edible nuts such as the Jamaica Cobnut, and the Candoo nut from Queensland [Irvine, 1980]. The range extends some 28,000 km. It is a relatively narrow, long strip, stretching almost three-quarters of the way around the planet — a shape virtually impossible to explain by mechanisms such as winds and ocean currents.

It is appropriate here to make another point. When you take into account the relatively fast rate at which plants evolve and genetically diverge (Propositions 2H, 2I), you have the implication that the whole of the Pacific has opened up very quickly and in relatively recent geological time. The links across the Pacific demonstrated here are, in fact, much stronger than those which exist across, say, the south Atlantic.

Proposition 4C

The Pacific Ocean is a relatively recent formation, and was largely created after the initial formation of the Atlantic Ocean

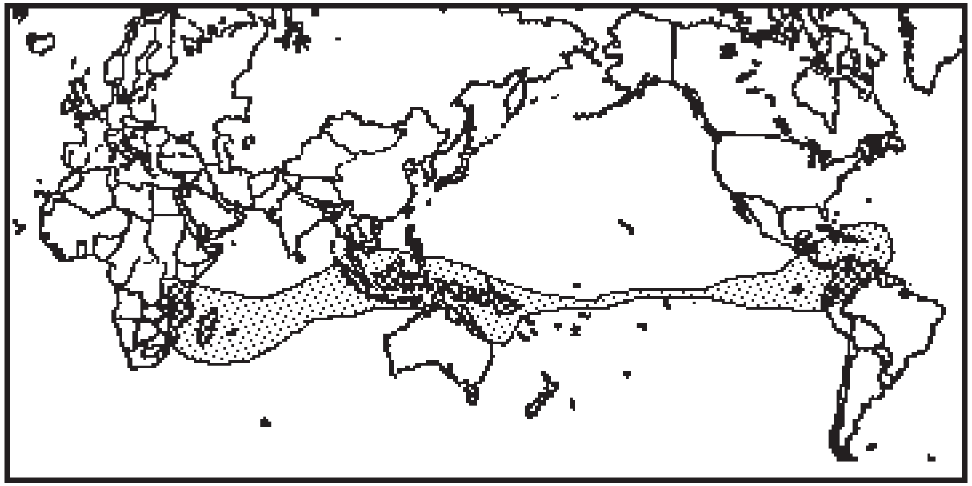

Fig. 4.9. Distribution of Omphalea

All the last seven species were ones with southern distributions. It appears that all developed in the southern 'supercontinent' of Gondwanaland, which included South America, Africa, Australia, India, and also Southeast Asia and Southern China. All fall within the current range of the Proteaceae (Fig. 4.1).

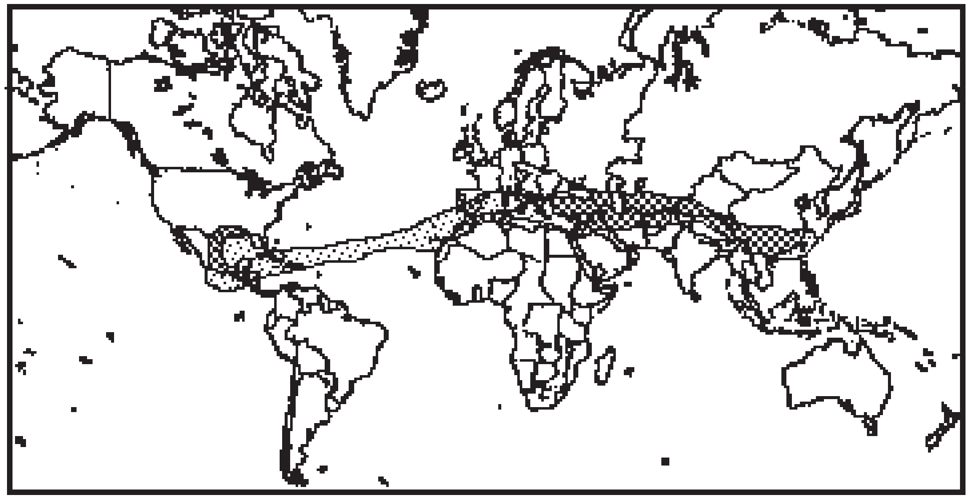

Fig. 4.10. Distribution of Pistacia

Proposition 4D
Gondwanaland included much of southeast Asia and southern China

The next map, showing the *Pistacia* family (Fig. 4.10), takes us into the northern supercontinent, Laurasia. As well as the pistachio nut and its relatives native to Central Asia,

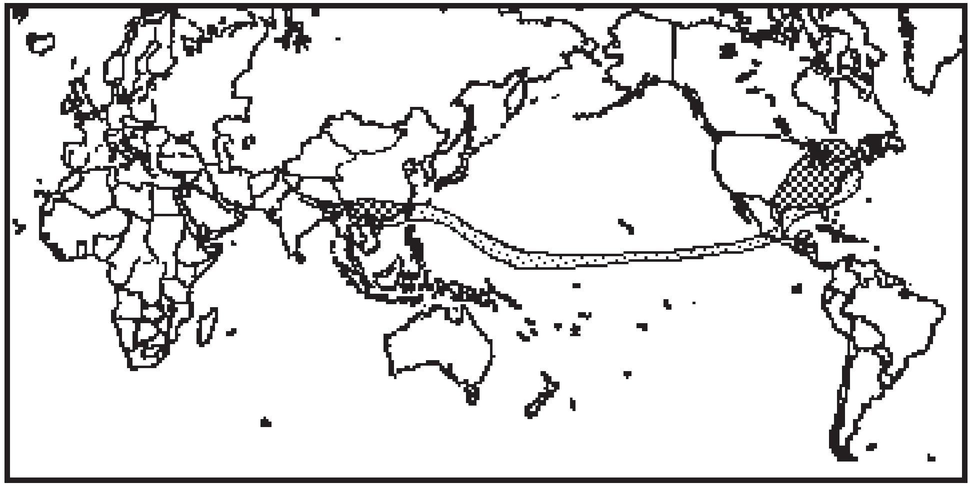

Fig. 4.11. Distribution of Carya

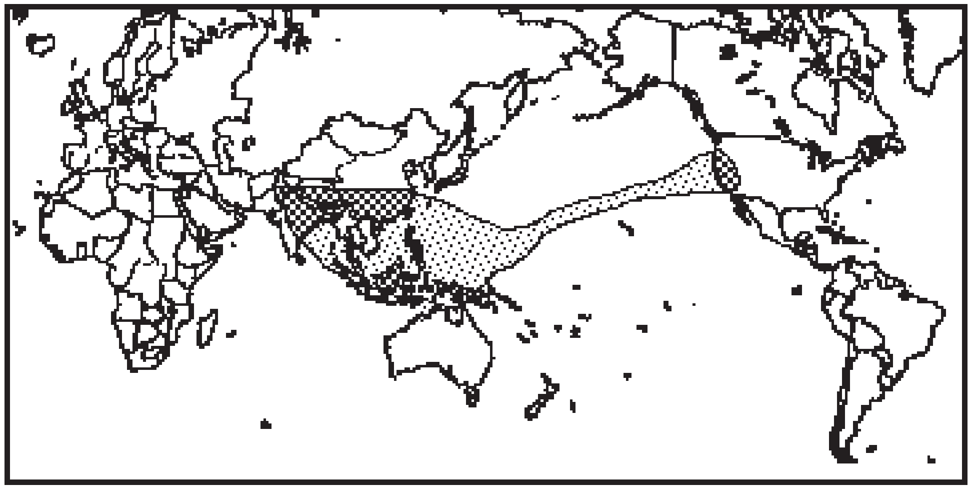

Fig. 4.12. Distribution of Castanopsis

the Mediterranean area, and the Middle East, there are other species in Burma, China, and the Atlantic islands over to Mexico, Texas, and Guatemala. The range confirms the former contact of Europe and North America, and is in no way unexpected.

Figure 4.11 illustrates the range of *Carya* species, the pecan and hickories. Almost all of these are in North America; however, a few little-known species are wild in China and the eastern Himalayas. The range confirms the former connection of North America and Asia across what is now the North Pacific.

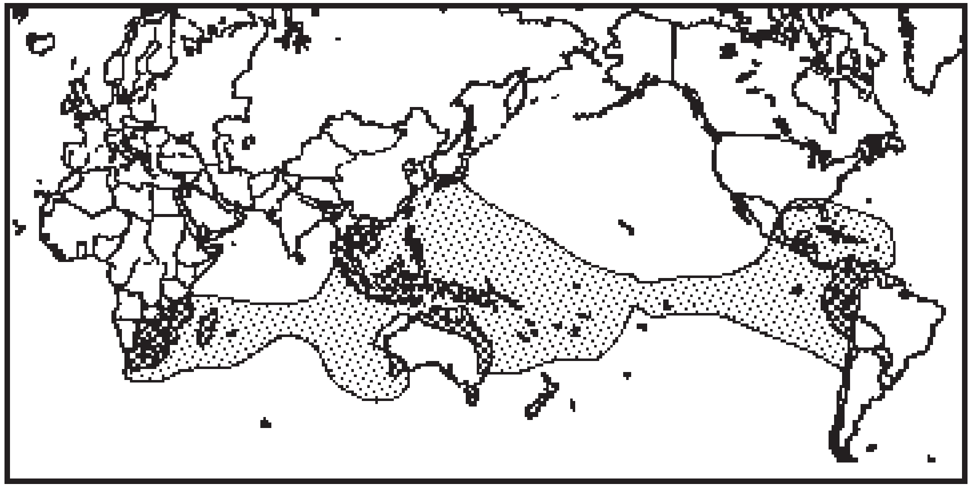

Fig. 4.13. Distribution of the Cycads

Figure 4.12 shows the range of the evergreen chestnuts, *Castanopsis*. They are almost all in Southeast Asia, around 100 species, with just two isolated species way across the Pacific on the west coast of the United States. If you think this could be due to ocean currents, consider that in both parts of the range, *Castanopsis* is a hill or mountain species which avoids seacoasts.

The maps for *Carya* and *Castanopsis* demonstrate that the links across the south Pacific are matched by ones across the north Pacific as well; Laurasia must have been wrapped round on itself too, as well as Gondwanaland.

The next map (Fig. 4.13) shows the distribution of cycads, the zamia palms common to areas which once formed part of Gondwanaland. Their nuts, after treatment to remove toxins, once formed part of the diet of the Australian aborigines. The cycads are a very ancient plant family, and their ancestors are known to be of world-wide occurrence from abundant fossil remains.

The implication of the map is that the modern species are not just those which happened to survive from a former world-wide distribution. Perhaps they are closely related, all coming from a common ancestor which achieved an evolutionary step, somewhere in Gondwanaland, which enabled it to adapt to changing conditions while its relatives became extinct. This particular distribution has a number of other implications which we will return to later.

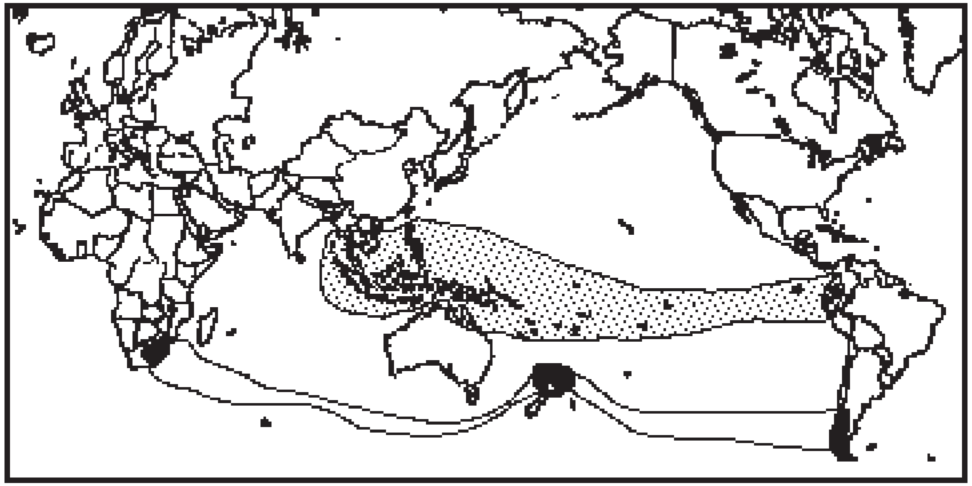

Fig. 4.14. Distribution of Cocos, Jubaea, and Jubaeopsis

Finally, the fascinating story of the coconut and its relatives. It is often possible to determine the original home of a species which has been widely dispersed from such things as the number of insects specific to it, or occurrence of close relatives. The coconut has baffled and confused researchers in the past [De Candolle, 1886; Eden, 1963] because there is strong

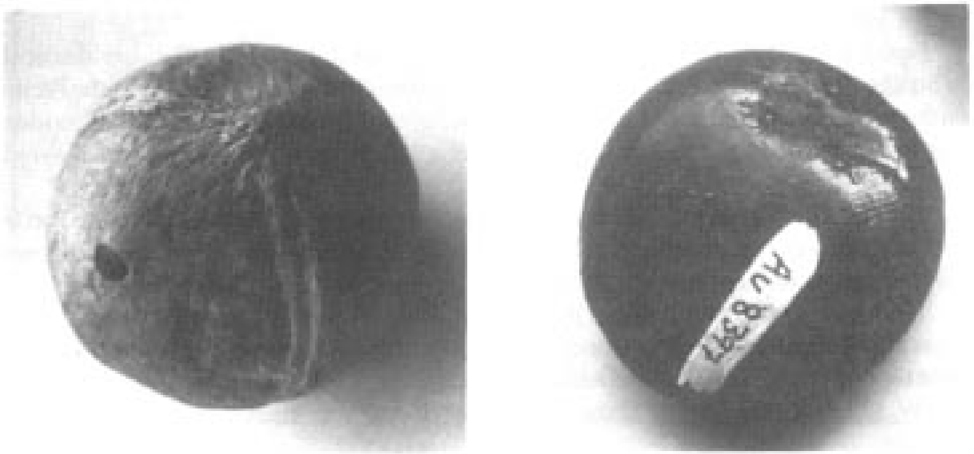

Fig. 4.15. Modern Jubaea *nut (left) and fossil 'coconut' from New Zealand*

evidence that it is a native of Southeast Asia (Fig. 4.14). There is also strong evidence that it is native tothe West Coast of northern South America. You can see now that both claims are right — its area of origin was split apart by Earth expansion.

The true coconut has some very interesting non-tropical relatives, the Pygmy Coconut from Chile (*Jubaea*), and the Pondoland Palm (*Jubaeopsis*) from Cape Province in South Africa. Their fruits are just like tiny coconuts, complete with the three eyes, and with a little 'milk' inside. They are very distinctive indeed, and although it is now extinct, what was almost certainly a close relative has been found as a fossil in North Auckland, New Zealand (Fig. 4.15). These 'fossil coconuts' are believed to be about 16-17*my* old [Grant-Mackie, 1986] — another indication that the separation of New Zealand from South America may not be so very old.

These interesting distributions are all readily explicable on the assumption that the current land areas of the Earth were once all physically linked, capping the whole surface of a much smaller sphere. The Earth has since expanded under this cap, which has split into parts which have become separated and, in some cases, moved relative to one another.

> *Proposition 4E*
> *The Earth's current continents were once all joined together to completely cover the surface of a much smaller sphere, which has since expanded*

In the next chapter we will go on to examine some of the details of this process. For the moment, we will just note that the 'unexpanded' Earth must have had less than 60% of the current radius. More detailed work suggests the figure was closer to 50%, a half-radius Earth.

If you find this Proposition hard to swallow, you should ask yourself, is there a better one? Certainly current explanations for such things as the close cross-Pacific links — usually based on hypothetical land bridges across the Bering Straits during glacial times — do not stand up to any sort of close scrutiny.

It is quite inconceivable that tropical Asian plant genera could migrate all the way north up the Bering Straits, pass over them when they were much colder and covered with more ice than now, then migrate down again to the American tropics, leaving no trace of their passage. And it is equally inconceivable that they could do this so quickly — the last glaciation ended only about 10,000 years ago, and the start of the Ice Age is not much more than a million years ago.

As Sherlock Holmes said, "when everything that is impossible has been eliminated, then what explanation remains, however improbable, must be the truth". We will go on to demonstrate that these explanations are not even improbable, but are supported by a solid weight of evidence.